# The Victorian Naturalist

The Magazine of the
FIELD NATURALISTS CLUB OF VICTORIA

in which is incorporated
THE MICROSCOPICAL SOCIETY OF VICTORIA

**Vol. 99**

**January-December, 1982**

COMPILED BY K. N. BELL

Jenkin Buxton Printers Pty. Ltd. 1-13 ABBOTSFORD ST. WEST MELBOURNE, 328-4774, 329-7959

# The Victorian Naturalist

Vol. 100, No. 1
Jan./Feb.
1983



Published by the FIELD NATURALISTS CLUB OF VICTORIA
in which is incorporated the Microscopical Society of Victoria

Registered by Australia Post. Publication No. V.B.P. 1268

$2.20

FNCV DIARY OF COMING EVENTS

## GENERAL MEETINGS

**Monday, 14 February, at 8.00 p.m.**

Mr Peter Brown: the role of zoos.

**Monday, 21 March, at 8.00 p.m.**

Pat Rich: fossil birds. Note change of date.

**Monday, 11 April, at 8.00 p.m.**

Dr Peter Jell: Evolutionary history of the Phyllum Echinodermata.

**Monday, 9 May, at 8.00 p.m.**

Annual general meeting. Election of Office Bearers and Council Members. Speaker: Miss W. Clark, FNCV President. Nominations will be required for Office Bearers and Council Members.

**New Members — January/February General Meetings.**

*Metropolitan*

Beryl Vangou, 15 Tramway Pde, Beaumaris. (Botany)
Mrs P. Weavers, 8 Ashburton Rd., Glen Iris. (Botany)
Mrs P. Reid, 43 Hanby St., Middle Brighton. (Botany)
Jeremy Gaden, Trinity College, Parkville.
Robin W. Wren, 1 Illuka Crescent, Mount Waverley.

*Joint*

Norm & Helen Sandford, 100 Middlesex Rd., Surrey Hills. (Botany and Geology)

## FNCV EXCURSIONS

**Sunday, 6 March.** Entomology excursion to Donna Buang. Leader: Mr P. Carwardine. Coach will leave Batman Avenue at 9.30 a.m. Fare $8.00 Bring a picnic lunch.

**Friday, 11 — Monday, 14 March.** Labour Day combined weekend. The VFNCA is holding its annual combined weekend at Kerang and the surrounding area which is noted for its water birds. Accommodation for FNCV members has been booked at Kerang Environmental Centre, located 18 km southwest of Kerang. The Centre (Macropus Park) is a demonstration conservation-controlled park close to 60 major lakes and swamps, ibis rookeries, etc. It provides accommodation for groups interested in the natural history of the area. Caravan sites are available, and also 2 hostels of 8 rooms each where full board is provided and rooms have ensuite facilities. Sheets, pillow-cases and towels are required. There may be a few extra rooms so members of other clubs who would like this accommodation should contact the Excursion Secretary to see if there are any spare beds. Enquiries regarding camp or caravan sites should be made direct to Mr G. Hardwick at the Centre. Proposed programme: Saturday — excursion to Mystic Park (birds and botany); Sunday — Pyramid Hill (birds, botany and geology); Monday morning — Reedy Lake; Saturday and Sunday evenings — meetings at the hall at the Centre. Current proposal is to reach Kerang by train and then use the Centre's bus, or go by private car. Train leaves Friday 5.40 p.m. and arrives at Kerang at 9.32 p.m.; it can be met by the Centre's bus. Return train leaves Kerang 5.16 p.m. Monday, to arrive in Melbourne 9.10 p.m. Accommodation is $20 per day full board. Return train $32. A deposit of $20 is required when booking.

Friday, 1 — Tuesday, 5 April. Easter. Members wishing to join Hawthorn Junior FNC Easter camp should contact Damien Cummins (82 5058 AH).

Sunday, 1 May. Understanding soils. Leader: Mr G. Love. Details next Naturalist.

## GROUP MEETINGS

FNCV members are invited to attend any Group Meeting.

Day Group — Third Thursday.

Thursday, 17 February. Polly Woodside and the maritime museum. Meet at the entrance at 11.30 a.m. Leader. E. Gillespie (578 1879).

Thursday, 17 March. Ricketts Point. Leader: D. McInnes (211 2427).

Thursday, 21 April. Puffing Billy. Leader: I. Gillespie (578 1879).

**At the National Herbarium, Birdwood Avenue, at 8.00 p.m.**

**First Tuesday — Mammal Survey Group.**

Tuesday, 1 March. Mountain pygmy possum. Ian Mansergh.

Tuesday, 29 March. April meeting.

Tuesday, 3 May. To be announced.

**First Wednesday — Geology Group.**

Wednesday, 2 March. Earth stresses and their effect on the landscape.

Wednesday, 6 April. Zeolited. Mr G. Love.

Wednesday, 4 May. The fertility of soils in respect to geological processes.

**Third Wednesday — Microscopy Group.**

Wednesday, 16 February. Plankton. Mr H. Bishop.

Wednesday, 16 March. The microscopists of England and Europe in the 19th century. Mr D. Wentworth.

Wednesday, 20 April. Insects. Mr Irwin Bates.

**Second Thursday — Botany Group.**

Thursday, 10 March. Trees. Pat Carolan.

Thursday, 14 April. Tundra. Mary Doery.

Thursday, 12 May, 1982 Western Australia expedition.

(Continued on inside back cover)




# The Victorian Naturalist

Volume 100, Number 1 January/February, 1983

ISSN 0042-5184





*Cover illustration:* Pit-fall trap used during survey of beetles in coastal N.S.W. (see article by Williams and Williams). The metal cover stops entry of rain.

# Temporal Abundance of Juveniles of a Monacanthid Fish (*Penicipelta vittiger* (Castelnau)) in Southern Port Phillip Bay

By Garry Russ*

**Summary**

Visual estimates of abundance of juveniles of a temperate reef fish, *Penicipelta vittiger* (Castelnau) (Monacanthidae), were made at a study site at the southern end of Port Phillip Bay, Victoria, at approximately biweekly intervals for 49 months. Abundance varied seasonally and annually. Large numbers were present only between December and May, and the greatest numbers recorded at the study site in different years varied by a factor of up to 3.6.

**Introduction**

Several recent experimental studies of communities of coral reef fishes in Australia have emphasised the variability of recruitment in both space and time and the important consequences of this for the structure of these communities (Russell *et al.* 1977, Sale and Dybdahl 1975, 1978, Talbot *et al.* 1978, Williams 1980, Williams and Sale 1981, Doherty in press). However, little information is available on temporal variability of recruitment of Australian temperate reef fishes. This paper reports on the temporal pattern of abundance of juveniles of the temperate reef fish *Penicipelta vittiger* (Castelnau) (Monacanthidae) at one site over a period of 49 months.

**Study Site and Methods**

The study was carried out at Portsea Pier in Weeroona Bay in the southeastern corner of Port Phillip Bay, Victoria (38°19'S: 144°43'E). Surface water temperatures vary from 10-11°C in winter to 20°C in summer (Russ, 1981) and the area is flushed regularly with water from Bass Strait by weak tidal currents. Weeroona Bay has a substratum of limestone, which in most areas is thinly covered with sand. The maximum depth of Weeroona Bay is 6 m and the substratum is dominated by the brown kelp *Ecklonia radiata* with small areas of the seagrass *Amphibolis antarctica*.

The study site measured 15 x 5 m and was located beneath the seaward end of the pier. The mean depth of water was 4.25 m below mean low water mark. The site included a series of artificial surfaces used in concurrent investigations of temporal change in the structure of a marine epifaunal community (Russ 1981, 1982) and of the effects of grazing by fishes on this community (Russ 1979, 1980).

Estimates of the number and average total length of juvenile *Penicipelta vittiger* in the study site were made visually, using SCUBA diving, at approximately 1 to 2 week intervals over the period November 1975 to December 1979 (49 months).

**Results**

Nearly all individuals of *P. vittiger* observed at Portsea Pier were juveniles ranging in length from 4 to 18 cm, which formed aggregations of 5 to 150 individuals under the pier. Figure 1 shows the abundance of juvenile *P. vittiger* in the study site throughout the study period. The abundance of juvenile *P. vittiger* varied seasonally, with large numbers being present only between December and May. The fishes grew

* Department of Zoology, University of Melbourne, Parkville, Victoria.
Current Address:
Australian Institute of Marine Science,
P.M.B. No. 3,
Townsville M.S.O., Qld. 4810.

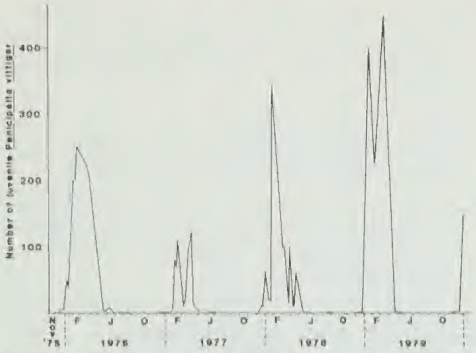



Fig. 1. Number of juvenile *Penicipelta vittiger* observed in the 15 x 5 m study site at Portsea Pier over a period of 49 months.

during this period, ranging from 3-12 cm in December up to 15-18 cm by May. There were rapid increases in abundance in December-January and equally rapid decreases in April-May.

The abundance of juvenile *P. vittiger* also varied between years (Fig. 1). The maximum numbers of juveniles observed within the study site in the summer periods of 1975/76, 1977/78 and 1978/79 were, respectively, 2, 2.8 and 3.6 times those observed in the summer of 1976/77.

**Discussion**

Personal observations suggest that juveniles of *Penicipelta vittiger* settle into the kelp beds near the pier, perhaps during the spring. The juveniles form aggregations utilizing the shelter of the kelp fronds and probably feed upon tubicolous amphipods, didemnid ascidians and hydroids attached to fronds (see Russ, 1980, 1981). It is hypothesized that at some time after settlement schools of these fishes were attracted to the study site because of the more abundant food (epifaunal invertebrates) and shelter available there than in the kelp beds. Recruitment into the kelp beds, possibly in distinct pulses, followed soon after by movement of the fishes in groups to the pier habitat could account for the very rapid increases in abundance observed in December/January. The abrupt decreases in abundance of juveniles at the end of autumn are likely to be due to the juveniles migrating to deeper water (J. B. Hutchins, pers. comm.).

Of the many factors which could influence year to year differences in the abundance of juveniles at the study site, the two most likely to be important are variations in the density of settlement into the kelp beds, and in the extent of movement from these areas to the study site. Observations suggested that the abundance of juveniles along the total length of the pier was less than though generally comparable with that in the study site. The patterns of abundance observed at the pier may reflect year to year variability in numbers of recruits of *P. vittiger* over larger areas such as Weeroona Bay.

The data presented here, covering five consecutive summer periods, demonstrate the pronounced seasonal nature of recruitment of a temperate reef fish, and suggest that the strength of this recruitment varies between years. Year to year variability in strength of recruitment has been shown to have a significant effect on temporal variability in the population densities of many fishes, both commercial, temperate species (Nikolskii 1969) and coral reef species (Williams 1980, Doherty, in press). Data on seasonal and annual variability in recruitment of temperate reef fishes will be of great value to conservation and management procedures within established and future marine parks in temperate areas.

**Acknowledgements**

Peter Doherty, Julie Harris, Barry Hutchins, Angus Martin and Dave Williams read the manuscript. Barry Hutchins identified the juvenile *Penicipelta vittiger*. This work was supported by a Commonwealth Postgraduate Research Award.

REFERENCES

Doherty, P. J. (in press). Coral reef fishes: recruitment-limited assemblages? In *Proc. 4th*

*Int. Coral Reef Symp.* Manila, Philippines 18-22 May, 1981 (Marine Sciences Center: University of the Philippines).

Nikolskii, G. V. (1969). *Theory of fish population dynamics as the biological background for rational exploitation and management of fishery resources.* Oliver and Boyd: Edinburgh.

Russ, G. R. (1979). The relationship of fish grazing to bryozoan and ascidian communities at Portsea Pier, Victoria, Australia (preliminary report). Abstract. In: *Advances in Bryozoology* (Eds. M. B. Abbott and G. P. Larwood) pp. 295. Academic Press: London.

Russ, G. R. (1980). Effects of predation by fishes, competition, and structural complexity of the substratum on the establishment of a marine epifaunal community. *J. exp. mar. Biol. Ecol. 42:* 55-69.

Russ, G. R. (1981). Patterns of establishment and subsequent change in the structure of a marine epifaunal community. Ph.D. Thesis. University of Melbourne.

Russ, G. R. (1982). Overgrowth in a marine epifaunal community: Competitive hierarchies and competitive networks. *Oecologia* (Berl.) *53:* 12-19.

Russell, B. C., Anderson, G. R. B., and Talbot, F. H. (1977). Seasonality and recruitment of coral reef fishes. *Aust. J. Mar. Freshwater Res. 28:* 521-8.

Sale, P. F. and Dybdahl, R. (1975). Determinants of community structure for coral reef fishes in an experimental habitat. *Ecology 56:* 1343-55.

Sale, P. F. and Dybdahl, R. (1978). Determinants of community structure for coral reef fishes in isolated coral heads at lagoonal and reef sites. *Oecologia* (Berl.) *34:* 57-74.

Talbot, F. H., Russell, B. C. and Anderson G. R. V. (1978). Coral reef fish communities: unstable, high-diversity systems? *Ecol. Monogr. 48:* 425-40.

Williams, D. McB. (1980). Dynamics of the pomacentrid community on small patch reefs at One Tree Lagoon (Great Barrier Reef). *Bull. Mar. Sci. 30:* 159-70.

Williams, D.McB. and Sale P. F. (1981). Spatial and temporal patterns of recruitment of juvenile coral reef fishes to coral habitats within "One Tree Lagoon", Great Barrier Reef. *Mar. Biol. 65:* 245-253.

# Patterns of Diversity and Abundance of Reef Fishes at the Portsea Pier in Southern Port Phillip Bay

BY GARRY RUSS*

**Summary**

Estimates of abundance of reef fishes were made along transects beneath the Portsea Pier in Southern Port Phillip Bay and in the *Ecklonia radiata* kelp beds near the pier in 1979. Two censuses taken in summer and a winter-spring census were compared. Maximum diversity and abundance of reef fishes occurred in the summer when there were significantly higher numbers of species and individuals of reef fishes beneath the pier than over the kelp beds. Fishes may be attracted to the pier because of the greater availability of food and shelter there than in the kelp beds. Most of the fishes attracted to the pier were juveniles of larger reef species or belonged to species consisting of small individuals. Piers may be nursery areas for some reef species, with the juveniles eventually migrating to offshore reefs many of which are included in the recently declared marine reserves in the area.

* Department of Zoology, University of Melbourne, Parkville, Victoria.
Current Address:
Australian Institute of Marine Science,
P.M.B. No. 3,
Townsville M.S.O.,
Queensland. 4810.

**Introduction**

The southern portion of Port Phillip Bay is one of the most popular sites on the Victorian coastline for diving and sport fishing, and also supports a commercial fishery. Parts of these areas have recently been declared as marine reserves. Little is known of seasonal and local patterns of diversity and abundance of reef fishes in the area; however observations made around Portsea Pier

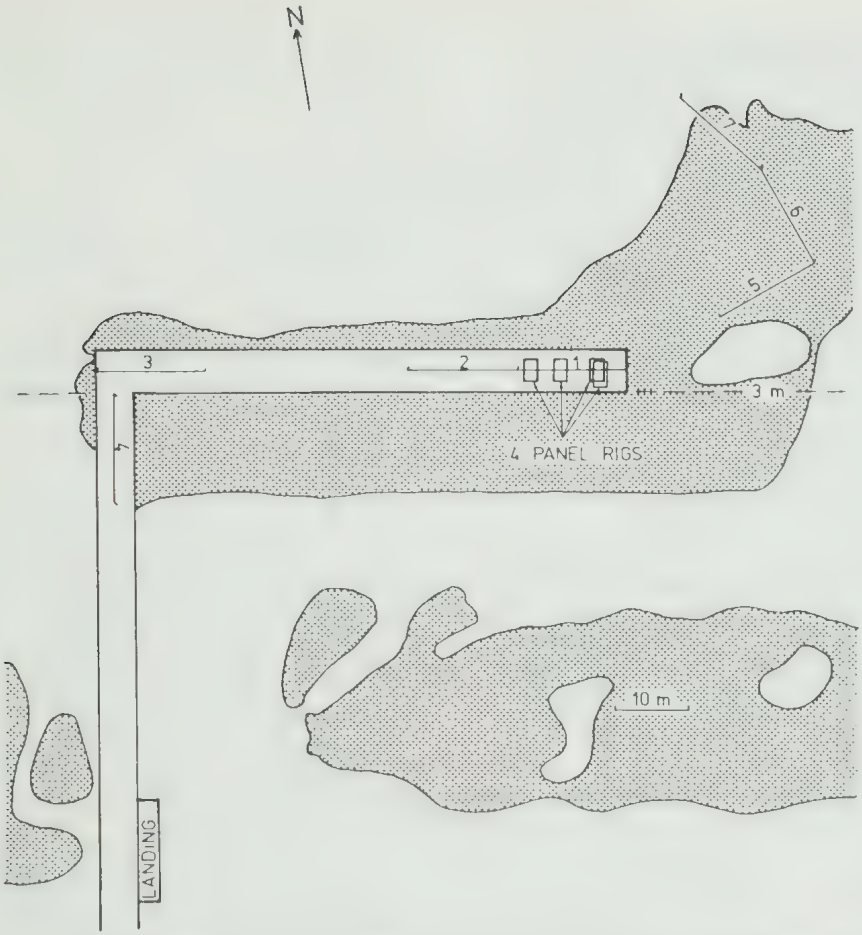



Fig. 1. The positions of seven 15 x 5 m transects beneath and adjacent to Portsea Pier. These transects were used in making estimates of population size of fishes. Areas of vegetation (mainly the kelp *Ecklonia radiata)* are shaded. An aerial photograph taken in 1968 was used to determine the distribution of vegetation. Observations suggest that the present distribution is similar to that recorded in 1968.

between 1975 and 1978 (Russ, 1981) revealed a pattern of marked seasonal fluctuation. The present paper reports on a census study carried out in 1979 to provide preliminary quantitative data on this seasonal pattern.

**Study Site and Methods**

The study was carried out at the Portsea Pier in Weeroona Bay in the southeastern corner of Port Phillip Bay, Victoria (38°19′S: 144°43′E). General details of the study site are given in Russ (1983). The substratum beneath the pier consists of sand and limestone rubble, sparsely covered with the kelp *Ecklonia radiata*. A dense cover of *E. radiata* extends up to the surface on the outer pilings of the pier.

Seven 15 x 5 m transects were established at the study site. There were four transects beneath the pier and three over the adjacent kelp beds (Figure 1). Transect 1 (T1) contained four angle-iron rigs (1.85 m long, 1.08 m wide and 1.65 m high), which were used to suspend frames of settlement panels used in studies of the marine epifaunal community (Russ 1979, 1980, 1981, 1982). Three panel rigs were located on the substratum at a depth of 4.25 m below mean low water mark and the fourth was suspended beneath the pier, approximately 2.4 m above the substratum.

The approximate positions of the four panel rigs are shown in Figure 1.

The remaining three transects beneath the pier (2, 3 and 4 in Figure 1) lacked panel rigs and were treated as replicates. Three replicate transects (5, 6 and 7 in Figure 1) were located adjacent to the pier at a depth of 4 to 5 m and had a substratum of limestone and sand with a dense cover of *E. radiata* 30 to 45 cm in height.

Estimates of population size of fishes were made visually, using SCUBA diving (the visual census method of Brock, 1954), on 14/2/79, 18/3/79 and 16/11/79. The first two periods are referred to as summer censuses and the third represents the situation observed typically in the winter-spring. The author swam the length of each transect recording numbers and total lengths of fishes throughout the water column within 2.5 m of the transect line on either side. Small, cryptic species such as blennies and gobies could not be counted and were ignored. The time spent at each transect was kept as constant as possible and ranged between 5 and 9 minutes. Data for number of species and individuals at each of two sites (pier = transects 2, 3, 4; kelp beds = transects 5, 6, 7) and three times (14/2/79, 18/3/79 and 16/11/79) were analyzed in a 2-Factor analysis of variance (Zar, 1974). The two factors in this analysis were sites and times and mean counts for sites and times were compared using the Student-Neumann-Keuls procedure (Zar, 1974). The significance level for all analyses was set at p 0.05. The mean numbers ( standard-error) of species and individuals of fishes and the mean numbers ( standard error) and size range of the ten most abundant species recorded in all transects in February (= summer) and November (= winter-spring) are tabulated.

**Results**

The analysis of variance and subsequent Student-Newman-Keuls analysis of number of species per transect indicated that, for each site (pier, kelp beds), there were no significant differences between the two summer censuses and that there were significantly more species per transect in summer (February, March) than in winter-spring (November). For all three time periods there were significantly more species per transect beneath the pier than over the kelp beds. Similar analyses of number of individuals per transect indicated that, for the pier site, there were no significant differences between the two summer censuses and that there were significantly more individuals per transect in summer than in winter-spring. For the kelp bed site there were no significant difference in numbers of individuals per transect with time. There were significantly higher numbers of individuals beneath the pier than over the kelp beds during the summer (February, March) but not during winter-spring (November). The mean numbers (± standard error) of species and individuals of fishes and the mean numbers (± standard error) and size range of the ten most abundant species recorded in all transects in February (= summer) and November (= winter-spring) are shown in Table 1. A complete list of the species of fishes observed in the vicinity of Portsea Pier is given in the Appendix. Transect 1 was considered distinct from the other three transects beneath the pier because of the presence of the panel rigs. It was not included in the analyses of variance. A greater number of species and individuals occurred at this rig site (T1) than in other areas beneath the pier (T2, T3, T4) and over the kelp beds (T5, T6, T7), particularly in summer, although insufficient data is available to test the significance of these results (Table 1).

Some general points can be made from the data in Table 1.

1) Many of the fishes beneath and close to the pier were juveniles of larger reef species or belonged to species consisting of small individuals.
2) Many species occurred in greater abundance during summer (February) than winter-spring (November).
3) Many species occurred in greater abundance beneath the pier than over the kelp beds.
4) Many species tended to occur in

Table 1 Mean numbers (± S.E.) of species and individuals of fishes recorded in 15 x 5 m transects at Portsea and species, mean numbers (± S.E.) and size range in cm (parentheses) of the ten most abundant species recorded in these transects during February and November, 1979. The positions of the transects are shown in Figure 1.

| Sampling Period and Location of Transects | FEBRUARY 1979 | | | NOVEMBER, 1979 | | |
|---|---|---|---|---|---|---|
| Species | Rig Site (T1) | Pier (T2,T3,T4) | Kelp Beds (T5,T6,T7) | Rig Site (T1) | Pier (T2,T3,T4) | Kelp Beds (T5,T6,T7) |
| Number of Species | 15 | 9.67±0.88 | 5.00±0.58 | 5 | 3.00±0.58 | 2.67±0.67 |
| Number of Individuals | 467 | 215.33±20.54 | 46.00±17.64 | 27 | 9.00±1.73 | 8.67±3.18 |
| Penicipelta vittiger | 225 | 176.67±19.22 | 35.67±20.88 | - | - | 0.67±0.67 |
| (Toothbrush Leatherjacket) | (4-12) | (4-12) | (4-12) | | | (10) |
| Pseudolabrus tetricus | 21 | 11.67±3.39 | 4.33±1.67 | 3 | 4.33±0.88 | 5.67±1.20 |
| (Blue-throated Parrot-fish) | (6-20) | (6-22) | (6-20) | (15-18) | (10-23) | (15-35) |
| Liopempheris multiradiata | 200 | 15.00±12.60 | - | 15 | - | - |
| (Common Bullseye) | (7-12) | (3-10) | | (3-5) | | |
| Atopomycterus nicthemerus | 4 | 2.33±0.88 | - | 1 | 3.67±2.19 | - |
| (Globe Fish) | (20-25) | (9-33) | | (25) | (18-35) | |
| Dinolestes lewini | 25 | 50.67±49.73 | - | - | - | - |
| (Long-Finned Pike) | (10-12) | (12-30) | | | | |
| Upeneichthys porosus | 2 | 0.33±0.33 | 1.33±0.88 | - | - | 0.33±0.33 |
| (Red Mullet) | (18-30) | (15) | (18-30) | | | (15) |
| Enoplosus armatus | 1 | 1.33±1.33 | 0.66±0.33 | - | - | 1.33±1.33 |
| (Old Wife) | (18) | (10-18) | (15-18) | | - | (12-18) |
| Conilstius vizonarius | 2 | 1.33±0.33 | - | - | - | - |
| (Magpie Perch) | (10-15) | (12-18) | | | | |
| Brachaluteres jacksonianus | 4 | 1.00±1.00 | 0.66±0.33 | - | 0.33±0.33 | - |
| (Pigmy leatherjacket) | (3-5) | (3-5) | (3-5) | | (5) | |
| Vincentiana novaehollandiae | 3 | 0.66±0.33 | - | - | - | - |
| (Southern Cardinal-fish) | (3-15) | (4-18) | | | | |

higher abundance at the rig site (T1) than in the other transects beneath the pier (T2, T3, T4).

The toothbrush leatherjacket accounted for the majority of individuals at most sites during the summer (Table 1). The individuals consisted entirely of juvenile fishes ranging in total length from 4 to 12 cm. Toothbrush leatherjackets commonly formed loosely aggregated schools of 5 to 150 individuals and were frequently concentrated in the area of the panel rigs and within the panel rigs themselves (Russ, 1981). There were higher numbers of juvenile toothbrush leatherjackets beneath the pier than over the kelp beds in summer (February, March) but not in winter-spring (November) and higher numbers of individuals in summer than in winter-spring both beneath the pier and over the kelp beds.

The blue-throated parrot fish was the only species recorded in every transect count during the study. The majority of these fishes were juveniles (Table 1). There was a higher proportion of small juveniles (6-8 cm total length) in the summer than in the winter-spring census. There were larger numbers of in-

dividuals at the rig site than at other sites in the summer due mainly to a concentration of small juveniles near the rigs. There were higher numbers of these fishes beneath the pier than over the kelp beds during summer and higher numbers beneath the pier in summer than in winter-spring. There was little difference in the numbers of this species over the kelp beds between summer and winter-spring.

The common bullseye formed schools of up to 200 individuals which concentrated in the panel rigs. They occurred in higher numbers beneath the pier than over the kelp beds in the summer and were absent from both these sites in the winter-spring (Table 1). The globe fish, long finned pike, southern cardinal fish and magpie perch were not observed over the kelp beds (Table 1). There was little difference in the abundance of the globe fish at the pier between summer and winter-spring, but both the long-finned pike and magpie perch were observed only during summer. The pigmy leatherjacket, southern cardinalfish and red mullet tended to occur in greater abundance at the panel rig site than in the other transects beneath the pier and also tended to occur in greater abundance beneath the pier than over the kelp beds. All three species were generally in higher abundance in summer than in spring. Old wife were also more abundant during summer (Table 1).

## Discussion

There were significantly higher numbers of species and individuals of reef fishes beneath the Portsea Pier than over the kelp beds adjacent to the pier during summer, the period of maximum diversity and abundance of reef fishes in this area. Fishes may have been attracted to the area of the pier because it offered more abundant shelter and, at least for those species which feed on sessile, benthic invertebrates, more abundant food, than did the kelp beds. Attraction of fishes to the pier seemed to be accentuated even further by the presence of the panel rigs, which provided hiding places and feeding areas for fishes (Russ, 1981). The pier as a whole and the panel rigs in particular seemed to act as artificial reefs which have been shown to increase the density of fishes relative to that in areas surrounding such reefs (Pollard, 1976).

There were low abundances of larger fishes beneath the pier but high numbers of individuals of small species and juveniles of larger species. The low abundances of larger fishes beneath the pier may be due to a higher incidence of fishing (angling, spearing, trapping) close to the pier. The significant decreases in diversity and abundance of small fishes around the pier between summer and the winter-spring period may be due to migration. Russ (1982 b) suggested migration as the cause of an abrupt decline in numbers of juvenile toothbrush leatherjacket at Portsea Pier in four successive autumn periods. The higher numbers of juvenile blue throated parrot-fish beneath the pier than in the kelp beds during summer, and the higher numbers and larger average size of individuals of blue throated parrot-fishes over the kelp beds in spring than in summer suggest that these fishes may move from the pier to the kelp beds during autumn-winter. Migration to offshore reefs after an initial period of residence at the pier during the summer may also occur in red mullet, old wifes and magpie perch. Thus piers such as those at Portsea, Queenscliff and Point Lonsdale may be nursery grounds for species of reef fishes which are common as adults in the recently declared marine reserves in southern Port Phillip Bay.

**Acknowledgements**

Julie Harris, Angus Martin and Dave Williams read the manuscript. This work was supported by a Commonwealth Postgraduate Research Award.

REFERENCES

Brock, V. E. (1954). A preliminary report on a method of estimating reef fish populations. *J. Wildlife Management 18:* 297-308.

Pollard, D. A. (1976). The history and development of artificial reefs around the world, with special reference to Australia. In: *Proceedings of the First Australian Conference on Artificial Reefs.* Brisbane (1975). Australian Underwater Federation, Brisbane.

Russ, G. R. (1979). The relationship of fish grazing to bryozoan and ascidian communities at Portsea Pier, Victoria, Australia (preliminary report). Abstract. In: *Advances in Bryozoology* Eds. M. B. Abbott and G. P. Larwood, pp. 295. Academic Press: London.

Russ, G. R. (1980). Effects of predation by fishes, competition, and structural complexity of the substratum on the establishment of a marine epifaunal community. *J. exp. mar. Biol. Ecol. 42:* 55-69.

Russ, G. R. (1981). Patterns of establishment and subsequent change in the structure of a marine epifaunal community. Ph.D. Thesis. University of Melbourne.

Russ, G. R. (1982). Overgrowth in a marine epifaunal community: Competitive hierarchies and competitive networks. *Oecologia* (Berl.) *53:* 12-19.

Russ, G. R. (1983). Temporal abundance of juveniles of a monacanthid fish (*Penicipelta vittiger* (Castelnau)) in southern Port Phillip Bay. *Victorian Nat. 100:* 4-6.

Zar, J. H. (1974). *Biostatistical Analysis.* Prentice-Hall, Englewood Cliffs, N.J.

**APPENDIX**

Teleost fishes observed in the vicinity of Portsea Pier.

| *Scientific Name* | *Common Name* |
|---|---|
| *Hemiramphus melanochir* (Cuv. & Valen.) | South Australian Garfish |
| *Trachichthys australis* Shaw & Nodder | Roughy |
| *Hippocampus abdominalis* Lesson | Big-Bellied Seahorse |
| *Phyllopteryx taeniolatus taeniolatus* (Lacepede) | Common Seadragon |
| *Platycephalus* sp. | Flathead |
| *Gymnapistes marmoratus* (Cuv. & Valen.) | South Australian Cobbler |
| *Trachurus mccullochi* Nichols | Yellowtail Scad |
| *Upeneichthys porosus* (Cuvier & Valenciennes) | Red Mullet |
| *Dinolestes lewini* (Griffith) | Long-Finned Pike |
| *Enoplosus armatus* (White) | Old Wife |
| *Vincentiana novaehollandiae* (Cuv. & Valen) | Southern Cardinalfish |
| *Liopempheris multiradiata* (Klunzinger) | Common Bullseye |
| *Vinculum sexfasciatum* (Richardson) | Moonlighter |
| *Parequula melbournensis* (Castelnau) | Silverbelly |
| *Goniistius vizonarius* (Saville-Kent) | Magpie Perch |
| *Psilocranium nigricans* (Richardson) | Dusky Morwong |
| *Cheilodactylus spectabilis* Hutton | Red-banded Morwong |
| *Scorpis* sp. | Sweep |
| *Bovichtus variegatus* Richardson | Dragonet |
| *Pictiblennius tasmanianus* (Richardson) | Blenny |
| *Petraites johnstoni* (Saville-Kent) | Johnston's Weedfish |
| *Verconectes bucephalus* (McC. & Waite) | Verco's Threefin |
| *Rhycherus filamentosus* (Castelnau) | Tasselled Angler Fish |
| *Pictilabrus laticlavius* (Richardson) | Senator Fish |
| *Pseudolabrus tetricus* (Richardson) | Blue-throated Parrotfish |
| *Haletta semifasciata* (Cuv. & Valen.) | Weedy Whiting |
| *Parma victoriae* (Guenther) | Scaly Fin |
| *Aspasmogaster tasmaniensis* (Gunther) | Tasmanian Clingfish |
| *Sphaeroides glaber* (Freminville) | Smooth Toadfish |
| *Atopomycterus nichthemerus* (Cuvier) | Globe Fish |
| *Aracana aurita* (Shaw) | Shaw's Cowfish |
| *Penicipelta vittiger* (Castelnau) | Toothbrush Leatherjacket |
| *Meuschenia freycineti* (Quoy & Gaimard) | Six-spine Leatherjacket |
| *Meuschenia flavolineata Hutchins* | Yellow-striped Leatherjacket |

| | |
|---|---|
| *Eubalichthys gunnii* (Gunther) | Gunn's Leatherjacket |
| *Eubalichrhys mosaicus* (Quoy & Gaimard) | Pigmy Leatherjacket |
| *Brachaluteres jacksonianus* (Quoy & Gaimard) | Pigmy Leatherjacket |
| *Scobinichthys granulatus* (Shaw) | Rough Leatherjacket |
| *Acanthaluteres spilomelanurus* (Quoy & Gaimard) | Bridled Leatherjacket |

# Pollination and Fruit Production of *Cupaniopsis anacardioides* (A. Rich.) Radlkf. (SAPINDACEAE) at Townsville, North Queensland. 1. Pollination and Floral Biology.

BY T. J. HAWKESWOOD*

**Abstract**

Observations on insect pollination vectors of *Cupaniopsis anacardioides* (A. Rich.) Radlkf. (Sapindaceae) were made on the 7 August, 1981 on the James Cook University grounds, Townsville, north Queensland (c. 19°15'S, 146°48'E). Six insect species were collected from the flowers and their pollen loads examined and compared. Only two insect species, *Stomorhina discolor* (Fabricius) (Diptera: Calliphoridae) and *Trigona carbonaria* Smith (Hymenoptera: Apidae) were common visitors. The most efficient pollinator is considered to be *T. carbonaria*. The flowers of *C. anacardioides* possess more features of cantharophily and myophily than melittophily, yet are mainly pollinated by small bees (i.e. *Trigona*) at Townsville. Further observations on pollination vectors throughout the plant's range and embryological studies are needed.

**Introduction**

*Cupaniopsis anacardioides* (A. Rich.) Radlkf. is a medium-sized, slender, mostly glabrous, tall shrub to tree, usually attaining a height of 3-5 metres, with compound leaves, belonging to the Sapindaceae.

According to Bentham (1863), *Cupaniopsis* (as *Cupania*), is a tropical genus of trees with all the Australian species being endemics. Oakman (1964) notes that *C. anacardioides* is indigenous to the east coast of Australia where it may be found growing in isolated clumps or as single specimens. According to Oakman (1964), although the species flourishes on the sandy coastal strips and its roots "reach a considerable distance to the water table", *C. anacardioides* is not affected by average winds and can withstand heavy salt sprays. It is thus a hardy tree and is particularly suitable for streets with considerable wind exposure in association with poor soil conditions (Oakman, 1964, p. 183).

The genus name (originally *Cupania* for the species) is derived from the Italian botanist, Francesci Cupani, and the specific epithet refers to the fruits which apparently resemble the cashew nut (*Anacardium*, Anacardiaceae) in general appearance (Oakman, 1964).

Despite this species being well-known in cultivation, little is known about its natural past or present distribution in eastern Australia, pollination ecology, fruit and seed production, and seed viability. Specimens of *C. anacardioides* which have been planted on the James Cook University campus, flowered during early to mid-July 1981 and thus provided an opportunity for subsequent study of some of these aspects.

*49 Venner Rd., Annerley, Brisbane, Qld. 4103.

**Materials and methods**

(a) Collection of insect pollination vectors and pollen examination.

Insects were randomly collected, using a hand net, from the open flowers of one tree of *C. anacardioides* (the most profuse flowering specimen) on 7 July 1981, between 1300-1350 hrs (EST). After capture, the specimens were carefully transferred from the net and deposited in a large glass killing jar containing a cotton wool pad sprinkled with ethyl acetate (as per Hawkeswood, 1981). The insects were then examined for pollen loads at James Cook University, Townsville, with the aid of a high-power dissecting microscope. Pollen grains were usually clearly visible as small to large clusters or individual grains, adhering to hairs or more usually to the general body surface of individual insects. Pollen grains from five bees (*Trigona carbonaria* Smith) and three flies (*Stomorhina discolor* (Fabricius)) were examined and compared under a 100X-1000X binocular microscope with grains from fresh, open flowers of *C. anacardioides*. The pollen grains from these insects were identical to those from the flowers, indicating that the insects were transporting pollen grains of *C. anacardioides*.

A list of the pollination vectors and data showing places of pollen deposition are provided in Table 1. Voucher collections of the fly species (Diptera) examined are deposited in the Australian National Insect Collection (ANIC) in Canberra, while voucher collections of the bees and wasps are deposited in the University of Queensland Insect Collection (UQ) in Brisbane. Voucher collections of *Cupaniopsis anacardioides* are deposited in the Queensland Herbarium (BRI) in Brisbane.

(b) Study site

Two plants from a group of 12 *C. anacardioides* trees (about 2.3-3.5 m high), planted in a row alongside a walkway in the centre of the James Cook University grounds, were examined in this study. On 9 July 1981, during flowering (flowering commenced on about 5 July and ceased on about 26 July 1981), samples of flowering branches were taken (using a long-handled pruner) from two trees (the most profusely flowering specimens). This procedure was undertaken in order to examine the number of open flowers and the number of flowers/inflorescence to gain a rough estimate of the number of flowers produced per tree (Table 2).

Other dicotyledonous plants which were also flowering on the University grounds at the time include species of *Thunbergia* (Acanthaceae), *Tridax* (Asteraceae), *Stenolobium* (Bignoniaceae), *Bauhinia* and *Caesalpinia* (Caesalpiniaceae), *Calliandra* (Mimosaceae), and *Antignon* (Polygonaceae). These were briefly examined for insect vectors in order to ascertain whether the insect species visiting *C. anacardiodes* also visited these other plants.

**Results**

(a) Pollen grains

The pollen grains of *Cupaniopsis anacardioides* (Fig. 1) are small, solitary, sub-triangular in shape, 3-porate (with three pores), 3-colpate (with three furrows), syncolpate (furrows of uniform width, orientated meridionally and fused at the poles) and have a distinctive sexine pattern (Fig. 1). The grains have an equitorial diameter of 8-10 μm and a polar axis of 6-8 μm.

(b) Pollination vectors

A total of 6 insect species (3 flies and 3 bees) were collected from the flowers (Table 1). Only two of these, i.e. *Stomorhina discolor* (Fabricius) (Calliphoridae) and *Trigona carbonaria* Smith (Apidae) were common (Table 1). On the other hand, *Dacus murrayi* (Perkins) (Tephritidae), *Baccha* sp. (Syrphidae), *Apis mellifera* Linnaeus (Apidae) and *Palaeorhiza* sp.

(Colletidae) were uncommon and an estimate of the numbers present for these species was not undertaken (Table 1).

The most important pollinator appears to be the workers of the small, black, native bee species, *Trigona carbonaria* Smith (body length 0.4-0.5 cm). All 12 specimens examined carried *Cupaniopsis* pollen, mostly on the abdomen and legs (Table 1); 8 specimens (66.6% of the total examined) carried large pollen bags on both the hind legs (Table 1). One bag from each of two bees was squashed under a coverslip on a microscope slide and examined with a compound microscope. Examinations showed that the bags comprised 100% of *Cupaniopsis* pollen, indicating that the bees were specific on *Cupaniopsis* flowers during the flowering of the species.

Specimens of *Trigona carbonaria* spent on the average 5-20 seconds feeding from individual flowers of *Cupaniopsis* before either (a) visiting 1 or 2 more flowers on the same inflorescence, (b) flying to another inflorescence on the same tree, (c) flying away to another tree nearby, or (d) flying away from the study area. Individual worker bees almost invariably contacted anthers and stigmas during flower visitation and pollen collection. The observations on *T. carbonaria* suggest that the species effects a high level of self-pollination (geitonogamy) of *C. anacardioides* at Townsville, and a low level of cross-pollination (xenogamy).

The calliphorid fly, *Stomorhina discolor* (Fabricius) (body length 0.55-0.7 cm) was common (Table 1) but only small amounts of pollen (usually less than 20 grains per fly) were found on their bodies (usually on the abdomen and legs, Table 1). The flies spent most of the time hovering in the air within one metre from the crowns of the trees or flying around the tops of the trees before rapidly darting into an in-

Table 1. Pollinators of Cupaniopsis anacardioides (A. Rich) Radlkf. on the James Cook University grounds, Townsville, north Queensland. (Places of pollen deposition on insects are shown by asterisks. Underline marks show where the majority of pollen was placed on the majority of specimens examined. Format follows that of Nilsson (1978) and Hawkeswood (1981)).

| Species | Number of specimens collected | [illegible] | Place of pollen deposition: [illegible] | | | Abdomen | | |
|---|---|---|---|---|---|---|---|---|
| DIPTERA | | | | | | | | |
| Calliphoridae | | | | | | | | |
| 1. Stomorhina discolor (Fabricius) | [illegible] | [illegible] | + | + | + | ± | ± | + |
| Tephritidae | | | | | | | | |
| 2. Lacus myrrayi (Perkins) | [illegible] | [illegible] | – | + | – | + | + | ± | – |
| Syrphidae | | | | | | | | |
| 3. Eristalis sp. | 1 | [illegible] | – | + | + | + | + | + | ± |
| HYMENOPTERA | | | | | | | | |
| Apidae | | | | | | | | |
| 4. Trigona (Tetragona) carbonaria Smith | 12 | [illegible] | + | + | + | + | ± | ± | + |
| 5. Apis mellifera Linnaeus | 2 | Unknown | + | + | + | + | ± | ± | + |
| Colletidae | | | | | | | | |
| 6. Paleorhiza sp. | 1 | unknown | – | – | + | + | ± | + | – |

florescence to feed on pollen (usually from only one flower), and then darting out again. They spent short periods of time feeding (5-15 seconds in most cases). When feeding, they often fed from outside the flower and not on the flower (i.e. stamens, petals and sepals) as did *T. carbonaria*. Some individuals of *S. discolor* were also observed to spend some time resting on leaves grooming the head, antennae and legs (tibiae). This behaviour may explain the absence of pollen on the antennae in 15 specimens examined (Table 1), while only 1-5 grains were detected on the head and eyes. The role of this fly in the pollination of *C. anacardioides* at Townsville is probably much less than that of *Trigona carbonaria* which carries larger pollen loads and is small enough to feed within the *Cupaniopsis* flower amongst anthers and stigmas thereby effecting pollination.

Due to their small numbers and amount of pollen carried on their bodies (often less than 20 grains per insect were detected), the native species of *Dacus murrayi* (Perkins) (body length 0.7-0.9 cm), *Baccha* sp. (body length 1.0-1.2 cm) and the green bee *Palaeorhiza* sp. (body length 1.3-1.5 cm), probably play a minor role in *C. anacardioides* pollination at Townsville. The majority of grains were carried on the legs of *Dacus murrayi*, on the wings of one specimen of *Baccha* sp. (the other specimen did not carry any pollen), and on the underside of the abdomen of *Palaeorhiza* sp. (see Table 1).

Pollen of *C. anacardioides* was detected on all parts of the body on the two specimens of *Apis mellifera* Linnaeus examined, but mostly on the abdomen and legs (Table 1). The feral bees are probably efficient pollinators of *C. anacardioides*, but due to their low numbers visiting flowers at the time of observations, they may not be as impor-

TABLE 2. Quantitative data on some flowering characteristics of two trees of Cupaniopsis anacardioides (A. Rich.) Radlkf. at Townsville, on 9 and 12 July, 1981.

| Date | Tree | Inflorescence Sample No. | Number of open flowers | Number of * flowers per inflorescence | Percentage (%) flowers open | Number of racemes per inflorescence |
|---|---|---|---|---|---|---|
| 9 July | 1 | 1 | 16 | 264 | 3.8 | 4 |
| | 1 | 2 | 42 | 362 | 11.6 | 6 |
| | 1 | 3 | 48 | 215 | 22.3 | 11 |
| 12 July | 1 | 1 | 9 | 290 | 3.1 | 5 |
| | 1 | 2 | 2. | 204 | 10.3 | 4 |
| | 1 | 3 | 42 | 298 | 14.1 | 7 |
| | 2 | 1 | 56 | 255 | 13.2 | 7 |
| | 2 | 2 | 0 | 332 | 0.0 | 9 |
| Totals | - | 8 | 198 | 2219 | - | 48 |
| Mean and standard deviation | - | - | 24.8±17.9 | 277.4±54.4 | 9.45±7.11† | 6.0±2.7 |
| Range | - | - | 0-48 | 204-362 | 0-22.3 | 4-11 |

* Inflorescence = One terminal (or axillary) panicle of racemes.

† These figures are the mean and standard deviation of the percentages. The average (mean) of the total number of open flowers/total number of flowers per inflorescence counted (i.e. 198/2219) is 0.0892 or 8.92%.

Fig. 1. Scanning electron micrograph of a fertile pollen grain of *C. anacardioides*, showing the tricolpate nature of the grain and the reticulate pattern of the sexine wall. Bar indicates 5 m (1 μm = $10^{-6}$ m).

tant as the native bees *Trigona carbonaria*.

(c) Observations on the flower

The actinomorphic (regular), usually bisexual flowers are small, (7-9 mm in diameter when fully open), (although according to Bentham (1863) they are large for the genus), and are arranged in long, axillary or terminal panicles of racemes, 18-35 cm long. Each flower has five, free sepals which are imbricate in bud. These sepals are orbicular in shape, with slightly ciliate margins; three are larger (c. 4.5 mm long, 3.0 mm wide) than the other two (c. 2.5 mm long, 2.5 mm wide). The petals are small, deltoid in shape, 1.5-1.8 mm long, acute, with two, very short, obovate, hirsute scales at the base. There are usually 8-10 stamens per flower, inserted between the ovary and the hypogynous disc surrounding the ovary. The anther filaments are short, c. 1.3-1.4 mm long, hirsute at the base, while the anthers are oblong, 1.8-2.1 mm long, and dehisce longitudinally. The ovary is hypogynous and villous with a short, simple style.

Flowers open in the early morning (c. 0700-0830 hrs, EST) and during the morning begin to emit a strong, distinctive, fragrant odour which persists into the afternoon. This period of scent production appears to correspond with the period when the insect visitors are most active. The flowers exhibit only slight protandry; the anthers dehisce immediately before or at about the time of anthesis (as indicated by dissecting closed and almost opened flowers). If the flowers are not pollinated by the early to mid afternoon, they fall from the plant during the late afternoon. Pollen, which is produced in large quantities per flower, appears to be the main attractant to the insect vectors, while the sweet-scented nectar produced from the very large hypogynous glands, may act as a secondary attractant luring the insects to the flowers.

The flowers appear to be functionally

bisexual, although the Sapindaceae are well-known for their polygamous flowers (i.e. the inflorescences have bisexual and unisexual flowers mixed together). Examination of numerous randomly selected flowers from different trees indicated that normally shaped, fertile pollen grains were produced by all flowers. All flowers had well-developed hypogynous glands and apparently a functional ovary and stigma. It is likely that the majority of *C. anacardioides* flowers are bisexual but a low percentage (i.e. $\leqslant 5\%$) are in fact, unisexual. This aspect of *Cupaniopsis* floral biology was not investigated in detail due to insufficient time.

In a sample of 8 inflorescences collected on 9 and 12 July 1981, at about 1550-1630 hrs (EST) between 0 and 48 flowers had opened during the day per inflorescence (Table 2) and were still persistant on the rhachis. The percentage of flowers open per inflorescence in the samples examined varied between 0.0% and 22.3% (Table 2), with an average of 9.45 ± 7.13% (Table 2). Considering an average of about 280 flowers per inflorescence (Table 2), then between 0% and 17% of the total number of flowers per inflorescence (or tree) are open per day. On average, the number of open flowers per inflorescence is 24.8 ± 17.9 (Table 2) and the number of flowers per inflorescence vary from 204-362 (Table 2) with an average of 277 ± 56.4 (Table 2). I have estimated that between 100-250 inflorescences were produced by the trees growing on the James Cook University grounds at Townsville. Using the average of 277 flowers/inflorescence, then *C. anacardioides* trees may produce between 27,000 and 69,000 flowers during the flowering season, although 25,000-35,000 flowers per plant (mature tree) may be a more conservative estimate since not all the trees produce as many as 250 inflorescences. *C. anacardioides* is indeed a mass-flowerer.

**Discussion**

(A) *Cupaniopsis* and the syndromes of pollination

The flowers of *C. anacardioides* are (a) actinomorphic, (b) have few visual attractions, (c) are shallow, bowl-shaped, (d) cream to greenish in colour, and (e) possess a strong, fragrant odour. The attractants for insects appear to be the pollen (which is produced in large quantities) and nectar. The anthers and stigmas are exposed i.e. positioned above the level of the sepals and petals, while the ovary is hypogynous with a prominent gland which secretes the nectar.

Faegri and Van der Pijl (1976) have outlined various pollination syndromes e.g. pollination by flies is known as myophily, by beetles, cantharophily, and bees, melittophily. According to these authors, flowers possessing the syndrome of melittophily have all or most of the following features: (a) zygomorphic flowers, (b) strong flowers capable of supporting the weight of bees, (c) yellow or blue flowers, (d) nectar guides present; nectar hidden but not very deep, produced in moderate quantities, (d) odour fresh but not strong, (e) stamens and stigmas hidden inside the blossom, and (f) hypogynous flowers. *C. anacardioides* possesses only one of these features, i.e. hypogynous flowers. Based on Faegri and Van der Pijl's criteria, the flowers do not appear to be adapted for melittophilly.

Plants with the syndrome of myophily (small fly blossoms) have (a) actinomorphic flowers, (b) simple and shallow flowers without impression of depth, (c) light, dull coloured flowers, (d) nectar guides usually present, (e) imperceptible odour, (f) anthers and stigmas well exposed, and (g) an epigynous or hypogynous ovary. *C. anacardioides* possesses most of these floral characters but has a strong, pungent odour and lacks nectar guides.

Plants which possess the syndrome of

cantharophily have all or most of the following features: (a) flowers with no special or definite shape, and few visual attractions; they are generally flat, cylindric, or shallow, bowl-shaped and easy of access, (b) flowers which are dull, greenish or cream and have easily accessible attractants such as nectar and pollen, (c) flowers with a strong, fruity or aminoid odour, (d) anthers and stigmas exposed, and (e) an epigynous ovary. *C. anacardioides* possesses all these features except an epigynous ovary.

*C. anacardioides* flowers appear to be adapted for cantharophily according to Faegri and Van der Pijl's criteria. However, a majority of the flowers usually hang downwards or are positioned perpendicular to the vertically hanging rhachises of the inflorescence, and are probably not suited for beetles which usually require an upright, flat flower upon which to land and feed. In addition, most Australian anthophilous beetles are present as adults between early summer and early autumn and very few, if any, are present during July and August when *C. anacardioides* flowers (this is especially so at Townsville, T. J. H. pers. obs.).

Only extensive field work through the range of *C. anacardioides* will show whether small, anthophilous beetles, e.g. Mordellidae, do pollinate the flowers or whether bees and flies are the dominant vectors throughout its distribution.

(B) Insects as pollinators

(a) *Trigona carbonaria* Smith (Apidae)

Michener (1961) presented data on the nest architecture of certain stingless bees of the genus *Trigona*, and noted that *T. carbonaria* Smith was very common in coastal Queensland and extended as far south as Sydney, N.S.W. Michener found the species common and widespread in areas around Brisbane and also collected it from Bundaberg, Gladstone and Mackay, usually at the edges of rainforest but occasionally in *Eucalyptus* savannah woodlands. Rayment (1932a) recorded the possibility of pollen grains of *Eucalyptus* (Myrtaceae) and *Hardenbergia* (Fabaceae) being food for the larvae of *T. carbonaria*, and also noted (Rayment, 1932b) stored pollen of the following native genera in nests of the species — *Eucalyptus*, *Angophora* (Myrtaceae), *Hardenbergia* (Fabaceae), *Cassia* (Caesalpiniaceae) and *Xanthorrhoea* (Xanthorrhoeaceae). However, he did not examine pollen loads of the adults nor emphasize their importance in pollination in these papers.

Michener (1965, pp. 243-244) collected *T. carbonaria* from a wide range of host plants but did not provide any information on the species pollination ecology. He records the following plants visited for pollen and/or nectar from southern Queensland and north-eastern N.S.W. — *Eucalyptus tessellaris*, *E. tereticornis*, *E. intermedia*, *Angophora subvelutina*, *A. woodsiana*, *A. intermedia*, *Leptospermum microcarpum*, *L. flavescens*, *Callistemon salignus*, *C. viminalis*, *Melaleuca sieberi*, *M. bracteata*, *M. linariifolia* (all Myrtaceae), *Persoonia virgata*, *Banksia* sp. (Proteaceae), *Pultenaea villosa*, *Daviesia squarrosa*, *Jacksonia scoparia*, *Oxylobium ilicifolium* (Fabaceae), *Hibbertia linearis* (Dilleniaceae) and other miscellaneous plants. *T. carbonaria* has not been recorded previously from *Cupaniopsis anacardioides*.

*Trigona carbonaria* appears to be an important pollinator of *C. anacardioides* at Townsville. Being only slightly smaller than the flower (body length of the bee 0.4-0.5 cm; flower width 0.6-0.7 cm when open), the bees when foraging, are able to turn and move about the flower while feeding on nectar and gathering pollen. Since they carry a majority of their pollen loads on

their abdomen (Table 1) they are likely to frequently contact and brush pollen onto the stigma during each visitation.

(b) *Palaeorhiza* sp. (Colletidae)

Little is known of the biology of *Palaeorhiza*. Michener (1965) states the genus is centred in Papua New Guinea and individuals are common in areas covered by tropical rainforest. The Australian species of *Palaeorhiza* are badly in need of revision. Rayment (1935) recorded *Eucalyptus* as a food plant for *Palaeorhiza*. The genus, as far as the author is aware, has not been recorded previously from *Cupaniopsis* flowers. Due to their rarity on *C. anacardioides* flowers at Townsville, they are unlikely to play a major role in pollination of this plant in this area. Observations in other areas (e.g. Cape York Peninsula, where the bees may be more common) may show *Palaeorhiza* species to be important pollinators of *Cupaniopsis* and other plants.

(c) *Stomorhina discolor* (Fabricius) (Calliphoridae)

Dear (1977, p. 794) in an excellent review on the Australian Rhiniinae (Calliphoridae) noted that *S. discolor* (Fabricius) has a wide distribution in the Oriental, Austro-Oriental, Australasian and Pacific regions. In Australia it has been recorded from all States except Tasmania and is most common in Queensland and N.S.W. Dear (1977) notes that adults are on the wing throughout the year but are more common during March, April, November and December. At Townsville, the species has been observed to have an association with termites (Isoptera); adults have been bred from *Mastotermes* nests (Dear, 1977). The present paper is the first to record this fly as a pollinator. They appear to be mainly pollen feeders but will also sip nectar. It is likely that *S. discolor* visits a wide range of flowering plants for food throughout its distribution. Further observations will greatly add to our ecological knowledge of this fly.

(d) *Dacus murrayi* (Perkins) (Tephritidae)

The Tephritidae are commonly known as fruit flies because the larvae are fruit-eating. Their role in pollination has not been investigated in Australia. Although not an important pollinator at Townsville, *D. murrayi* (Perkins) may be more imporant in *C. anacardioides* pollination in other areas where they are more common.

(e) *Baccha* sp. (Syrphidae)

The Syrphidae are a common, widespread family of flies, many species of which are known to be pollinators (e.g. Proctor and Yeo, 1973). *Baccha* has not been previously recorded as a pollinator in Australia. Hardy (1933) recorded two species of *Baccha* (i.e. *B. monobia* Terry and *B. siphanticida* Terry) from Australia, but the genus is badly in need of revision. Further observations and collections of these flies should lead to a better understanding of their ecology.

**Acknowledgements**

Firstly, I would like to thank Dr D. H. Colless, C.S.I.R.O. Division of Entomology, Canberra, for kindly identifying the three species of Dipteran pollinators, and Dr E. M. Exley, Department of Entomology, University of Queensland, St Lucia, for identifying *Trigona carbonaria* and *Palaeorhiza* sp. I would also like to acknowledge Prof. D. J. Griffiths, Botany Department, James Cook University, Townsville for providing microscopes and other facilities in order that this work could be undertaken. The assistance of James Cook University Research Grant UC-127-M allocated to the author, which greatly assisted completion of the manuscript is gratefully acknowledged. Thanks are also expressed to Mr J. J. Darley and Miss Sue Thompson, EM Unit, James Cook University, for assistance with the Scanning Electron Microscope. I express my gratitude to Drs R. W. Johnson and G. P. Guymer, Mr L. Pedley, Mr N. Byrnes and Ms S. T. Reynolds, Queensland Herbarium, Indooroopilly, Brisbane, for assistance and

discussion during my many visits to the Herbarium and Mr T. D. Stanley for compiling a checklist of *Cupaniopsis anacardioides* specimens from the Queensland Herbarium. Mr L. Pedley reviewed a final draft of the manuscript. Lastly, but not least. I thank my mother, Mrs D. E. Hawkeswood, for facilities provided in order that this paper could be written.

REFERENCES

Bentham, G. (1863). *Flora Australiensis.* Volume 1. (Reeve & Co., London). 508 pp.

Dear, J. P. (1977). A revision of Australian Rhiniinae (Diptera: Calliphoridae). *Aust. J. Zool. 25,* 779-826.

Hardy, G. H. (1933). Notes on Australian Syrphinae (Diptera). *Proc. Roy. Soc. Qld. 45,* 12-19.

Hawkeswood, T. J. (1981). Insect pollination of *Angophora woodsiana* F. M. Bail. (Myrtaceae) at Burbank, south-east Queensland. *Victorian Nat. 98,* 120-129.

Michener, C. D. (1961). Observations on the nests and behaviour of *Trigona* in Australia and New Guinea (Hymenoptera, Apidae). *Amer. Mus. Novitates 2026,* 1-46.

Michener, C. D. (1965). A classification of the bees of the Australian and Pacific regions. *Bull. Am. Mus. Nat. Hist. 130,* 1-362.

Nilsson, L. A. (1978). Pollination ecology of *Epipactus palustris* (Orchidaceae). *Bot. Notiser 131,* 355-368.

Oakman, H. (1964). *Cupaniopsis anacardioides. Australian Plants 2,* 183-184.

Proctor, M. and P. Yeo. (1973). *The Pollination of Flowers.* (Collins, London). 418 pp.

Rayment, T. (1932a). The stingless bees of Australia. 4. The larval bee. *Victorian Nat. 49,* 9-15.

Rayment, T. (1932b). The stingless bees of Australia. 2. The architecture. *Victorian Nat. 48,* 203-212.

Rayment, T. (1935). *A Cluster of Bees.* (Endeavour Press, Sydney). 752 pp.

# Fanny Anne Charsley and Her Wildflower Paintings

By A. K. Cavanagh*

Among early botanical illustrators of our native plants, none is seemingly so little known as Fanny Anne Charsley. Even J. H. Maiden in his "Records of the Victorian Botanists" (Maiden 1908, P.105), usually a mine of information on obscure botanists and plant collectors, devotes only three lines to her and these add little beyond what could be obtained from reading the foreword to her book, except for the fact that she was the daughter of a solicitor. Yet as far as I can ascertain, she was the first person to publish a "popular" illustrated work on Victorian flora, her "Wildflowers Around Melbourne" which appeared in 1867 (Charsley 1867). A few years earlier, the equally obscure Fanny Elizabeth de Mole had produced a similar book "Wildflowers of South Australia" and these two works are among the earliest publications dealing solely with our native flora.

I became interested in Miss Charsley after seeing a reference to her in Carr and Carr's "People and Plants in Australia" (Carr, 1981). Several copies of Charsley's book exist in Victoria but it contains almost no biographical information. She is not listed in any of the standard Australian Biographies nor in the Australian Encyclopaedia and I was unable to learn anything of her background until I discovered a biographical sketch by a nephew, Mr George H. Charsley, which appeared in *The Victorian Naturalist* of March 1933, p.261 (Anon 1933). This is reproduced in full below but I would be interested to learn of any other information which exists, especially concerning her life here in Australia in the period 1856-1866.

> "Fanny Anne Charsley was a daughter of the late John Charsley, of Beaconsfield, in Buckinghamshire (he was coroner for South Bucks), and a sister of the late Edward Charsley, of Melbourne, solicitor. Born at Beaconsfield on July 23, 1828, she was one of five sisters, who were all successful amateur painters in water colours.
>
> In 1856 Miss Fanny Charsley accompanied a married sister and her husband to Melbourne and while residing there executed a set of water colour drawings of wild flowers. She returned to England in 1866, when her drawings were published in book form, under the title *The Wild Flowers Around Melbourne* (London, 1867). The book contains thirteen large quarto lithograph (or zincograph) plates of excellent drawings of the flowers, coloured with perfect accuracy. The botanical names and classification of the flowers were added by Baron Ferdinand von Mueller; and, in recognition of the botanical value of the book, a new Australian flower was named after the artist, viz., *Helipterum Charsleyae* (see *Fragmenta Phytographiae Australiae*, No. LXVI).
>
> In 1889 Miss Charsley and her surviving sisters removed to Hove, in Sussex, where she died on December 21, 1915. After her return to England, she painted a large number of beautiful pictures of English wild flowers, which are carefully preserved among the present members of the family."

**The Plants Themselves**

What of the plants illustrated by Miss Charsley? All told there are 58, arranged in 13 large hand-coloured plates, and all were found close to the Melbourne that existed in the 1860's. Though every effort was apparently made by Miss Charsley to render the colours as truly as possible, they have suffered somewhat in reproduction and some of the illustrations are not very clear or show faults such as colour over-running the boundaries of flowers and stems. Additionally, some plates have too many flowers and this makes it difficult to gain a proper impression of many of the plants. Plates 8, 10 and 13 are

* Div. Mechanical Engineering, Deakin University, Vic. 3217.

Plate 8

Plate 10

to give readers an idea of Miss Charsley's presentation.

Some plants were quite rare even then eg. *Grevillea Latrobei* (now *G. lanigera* form) was found at only one place within a few miles of Melbourne, on ridges especially near watercourses. Because the 58 plants described provide a short check-list for the Melbourne area, I have tabulated them by plate number, together with their current names — Table 1. I wonder how many can still be found within the confines of the Melbourne area?

Some interesting comments have been provided in the text accompanying the plates, presumedly by Ferdinand von Mueller who named and classified the plants illustrated. Thus the narrow bulbs of the rootstock of *Thysanotus patersonii* were eaten by the aborigines as were the fruits of *Billardiera scandens*. Mueller, in constant touch with the great botanic gardens of Europe, was very keen to see our plants introduced there. He sent tubers of the orchid *Thelymitra ixioides* to Kew, noting that they were also a source of food for the aborigines. Of *Ricinocarpus pinifolius*, the comment is made:— "it has never been raised from seed nor has it reach-

Plate 13

ed Europe alive. It would be much admired if its transportation could be accomplished"; of *Caladenia pulcherrima* — "it deserves a place in every conservatory" —; of *Hardenbergia monophylla* (now *H. violaceae)* — "it has long been known in Europe." I was also interested to see that *Mesembryanthemum australe* was even then "the pig face of the settlers" but what is the origin of this rather ugly name for a beautiful flower?

Fanny Charsley's book was a pioneering work in helping to popularise native plants. It is hoped that this note will remove some of the obscurity that surrounds her and bring her work before a wider public.

**Acknowledgement**

I am particularly grateful to Miss Helen Cohn, librarian of the National Herbarium, Melbourne for her considerable assistance in locating the material used in writing this article.

REFERENCES

Anon (1933) "Melbourne's Pioneer Flower Painter" *Victorian Nat. 44*, 261.

Carr, D. J. (1981) "The Contribution of Women to Australian Botany" pp. 325-332, in Carr, D. J. and S. G. M. Carr (eds) "People and Plants in Australia". Acedemic Press Australia, Sydney.

Charlsey, Fanny Anne (1867) "Wildflowers Around Melbourne" Day and Son (Ltd) London.

Maiden, J. H. (1908) "Records of Victorian Botanists". *Victorian Naturalist 25*, 101-107.

*TABLE 1:*

**Plants Painted by F. A. Charsley from the Vicinity of Melbourne, 1856-1866.**

| Charsley Name | Present Name |
|---|---|
| Plate 1 | |
| *Correa speciosa* (Andr.) *var virens* Sm. | *C. reflexa* (Labill.) Vent. |
| Plate 2 | |
| *Epacris impressa* Labill. | *E. impressa* Labill. |
| Plate 3 | |
| *Dichopogon laxum* | Probably *D. strictus* (R.Br.) R. G. Bak. |
| *Villarsia parnassifolia* R.Br. | *V. reniformis* R.Br. |
| *Patersonia glauca* R.Br. | *P. fragilis* (Labill.) Druce |
| Plate 4 | |
| *Kennedya prostrata* R.Br. | *Kennedia prostrata* R.Br. |
| *Ricinocarpus pinifolius* Desf. | *R. pinifolius* Desf. |
| *Thysanotus patersonii* R.Br. | *T. patersonii* R.Br. |
| Plate 5 | |
| *Thelymitra ixioides* Swartz | *T. ixioides* Swartz |
| *Thelymitra aristata* Lindl. | *T. aristata* Lindl. |
| *Burchardia umbellata* R.Br. | *B. umbellata* R.Br. |
| *Stypandra caespitosa* R.Br. | *S. caespitosa* R.Br. |
| *Stypandra umbellata* R.Br. | *S. umbellata* R.Br. |
| Plate 6 | |
| *Thysanotus tuberosus* R.Br. | *T. tuberosus* R.Br. |
| *Billardiera scandens* Sm. | *S. scandens* Sm. |
| Plate 7 | |
| *Thelymitra antennifera* Hook. f. | *T. antennifera* (Gunn ex Lindl.) Hook. f. |
| *Diuris elongata* Swartz | *D. punctata* Sm. |
| *Diuris oculata* F. Muell ≡ *D. sulphurea* R.Br. | *D. sulphurea* R.Br. |
| *Glossodia major* R.Br. | *G. major* R.Br. |
| *Caladenia alata* R.Br. | *C. carnea* R.Br. |
| *Utricularia lilacina* | ? |
| *Caladenia pulcherrima* F. Muell. | *C. patersonii* R.Br. |

| | |
|---|---|
| Plate 8 | |
| *Daviesia ulicina* Sm. ≡ *D. umbellata* D.C. | *D. ulicifolia* Andr. |
| *Hardenbergia monophylla* Benth. | *H. violacea* (Schneev.) Stearn |
| *Acacia oxycedrus* Sieb. ex D.C. | *A. oxycedrus* Sieb. ex D.C. |
| *Clematis microphylla* D.C. | *C. microphylla* D.C. |
| *Leptospermum laevigatum* (J. Gaert.) F. Muell. | *L. laevigatum* (J. Gaert.) F. Muell. |
| Plate 9 | |
| *Bossiaea cinerea* R.Br | *B. cinerea* R.Br |
| *Platylobium obtusangulum* Hook. | *P. obtusangulum* Hook. |
| *Aotus villosus*, ≡ *A. villosa* (Andr.) Sm. | *A. ericoides* (Vent.) G. Don |
| *Dillwynia cinerascens* R.Br. | *D. cinerascens* R.Br. |
| Plate 10 | |
| *Tetratheca ciliata* Lindl. | *T. ciliata* Lindl. |
| *Hibbertia fasiculata* R.Br. ex D.C. | *H. fasiculata* R.Br. ex D.C. |
| *G. latrobei* Meissn., ≡ *G. ericifolia* R.Br. | ?*G. lonigera* A. Cunn. |
| *Hakea ulicina* R.Br. | *H. ulicina* R.Br. |
| *Wahlenbergia gracilis* (Forst.et f.) Schrad. | *W. gracilis* (Forst. et f.) Schrad. |
| Plate 11 | |
| *Goodenia geniculata* R.Br. | *G. geniculata* R.Br. |
| *Leptospermum myrsinoides* Schlecht. | *L. myrsinoides* Schlecht. |
| *Viola betonicifolia* Sm. | *V. betonicifolia* Sm. |
| *Caesia coryombosa* R.Br. | *Chamaescilla coryombosa* (R.Br.) F. Muell. ex Benth. |
| *Anguilaria dioica* R.Br. | *A. dioica* R.Br. |
| *Drosera auriculata* Backh. ex Planch. | *D. auriculata* Backh.ex Planch. |
| *Bulbine bulbosa* R.Br. | *B. bulbosa* R.Br. |
| *Stylidium gramminifolium* Swartz. | *S. gramminifolium* Swartz |
| *Viola hederacea* Labill. | *V. hederacea* Labill. |
| Plate 12 | |
| *Brunonia australis* Sm. ex R.Br. | *B. australis* Sm. ex R.Br. |
| *Craspidea richea* Cass. | *C. glauca* (Labill.) Spreng. |
| *Dianella revoluta* R.Br. | *D. revoluta* R.Br. |
| *Lobelia pedunculata* R.Br. | *Pratia pedunculata* (R.Br.) Benth. |
| *Convolvulus erubescens* Sims | *C. erubescens* Sims |
| *Ammobium alatum* R.Br. | *A. alatum* R.Br. |
| *Helichrysum bracteatum* (Vent.) Andr. | *H. bracteatum* (Vent.) Andr. |
| *Lobelia simplicaulis* R.Br. | *?L. gibbosa* Labill. |
| Plate 13 | |
| *Gompholobium hueglii* Benth. | *G. hueglii* Benth. |
| *Dianella longifolia* R.Br. | *D. laevis* R.Br. |
| *Pimelia humilis* R.Br. | *P. humilis* R.Br. |
| *Mesembryanthemum australe* Soland. | *M. australe* Soland. |
| *Comesperma calymega* Labill. | *C. calymega* Labill. |

# A Survey of the Aphodiinae, Hybosorinae and Scarabaeinae (Coleoptera: Scarabaeidae) from Small Wet Forests of coastal New South Wales, Part 2: Barrington Tops to the Comboyne Plateau.

BY G. A. WILLIAMS* AND T. WILLIAMS*

**Abstract**

Records of Aphodiinae, Hybosorinae and Scarabaeinae taken at wet forests in the Barrington Tops, Copeland and Dingo Tops and the Comboyne Plateau are listed. Data includes dates of collection, numbers of individuals encountered, bait type or collection method used, vegetation type, soil type and groundcover. Significant distributional extensions are listed for a number of species and the occurrence of partial carpophagy is recorded for the first time in the Australian Scarabaeini and Coprini.

**Introduction**

Part 2 of this study records the results from the baited pit-fall trapping of dung beetles undertaken in the high altitude, and associated escarpment, wet forests situated from the Barrington Tops region northeast to the Comboyne Plateau, New South Wales.

The first part (Williams and Williams 1982) surveyed sites between Nowra and Newcastle on the New South Wales south and central coast. Survey results from the lower near-coastal mountains and littoral rainforests to the east, of the region covered in Part 2, will be published in latter parts.

A survey of the region is of interest as previously documented records are restricted to the southeast section of the Barrington Tops (mainly the Upper Allyn and Barrington Guest House area) and the Comboyne Plateau (Matthews 1972 and 1974). The species previously recorded from the wet forest types of these areas were few and the fauna of the extensive intervening forests are unrecorded.

A minimum of two baited pit-fall traps were placed at each site per visit and frequently a variety of bait types were simultaneously offered. A map of the study sites is given in Fig. 1. Descriptions of site vegetation, soil type and groundcover are briefly given in Table 1. A list of species encountered is given in Table 2.

**Discussion**

Increasingly north from Sydney there is to be found a greater degree of generic diversity and species numbers within the Australian wet forest restricted dung beetle fauna. The combination of low temperatures and low rainfall restricts much of the fauna to the northeast corner of the continent. However, the Hawkesbury Sandstone country of the Sydney region may also impose a further impediment to the potential southward movement of species. The bedrock of this region weathers to a poor soil type upon which relatively little rainforest or wet sclerophyll forest is established.

North of Newcastle, along the Great Dividing Range, are to be found more expansive tracts of wet forest established on richer basaltically derived soils. These forests form the southern end of a line of spatially more substantial wet forest types extending northwards into southeast Queensland. There is an outlying isolated tract of rainforest in the Liverpool Ranges to the west of Barrington Tops and to the south rainforest

*c/o Post Office,
Lansdowne via Taree.
N.S.W. 2430.


Fig. 1. Map of Study sites.
A. Allyn River Forest Park. Chichester State Forest.
B. Copeland Tops State Forest.
C. Mitchell's Creek Rest Area. Barrington Tops State Forest.
D. Moppy Lookout Rest Area. Barrington Tops State Forest.
E. Dingo Tops Forest Park. Dingo State Forest.
F. Boorganna Nature Reserve.

Fig. 2. Comboyne Plateau rising from the northwest corner of the Manning Valley, north N.S.W

is restricted to a series of disjunct "islands". In the Wollemi National Park to the south of the Barrington Tops there are a series of mountain peak-restricted rainforests that were not sampled in Part 1; these include Mounts Kerry, Coriaday and Monundilla. A survey of the mountain associated wet forests of this region would be of interest to ascertain the distributional demarcation of the two known species of the genus *Aptenocanthon* (*A. hopsoni* (Carter) and *A. rossi* Matthews), the only endemic genus to the total study area.

A number of significant range extensions were noted during this part of the

survey; previous published records are given.

*Onthophagus arrilla* Matthews was previously recorded from the Queensland-New South Wales border (Matthews 1972) and *O. longipes* Paulian had been recorded from southern Victoria, the Australian Capital Territory and the New South Wales south coast (Matthews 1972, Williams and Williams 1982). *Onthophagus kiambram* Storey is recorded from southeast Queensland (Storey 1977) and (as *O. tuckonie* Matthews) from Dorrigo and the Gibralter Range of far northern New South Wales (Matthews 1972). It commonly was encountered from a number of our study sites south to Dingo Tops but was absent from sites further to the south (Williams and Williams, this Part and 1982).

*Amphistomus primonactus* Matthews was previously recorded from the Dorrigo and New England National Parks (Matthews 1974) approximately 140km to the north whilst the range of *Aptenocanthon hopsoni* (Carter) is extended from the Barrington Tops (Matthews 1974) to the Comboyne Plateau. Interestingly, this species does not reach the Lansdowne State Forest just several kilometres to the east of the Comboyne Plateau. Though Lansdowne State Forest is of comparable altitude in its northwest sector and possesses a wide variety of wet forest types extensive trapping has failed to encounter *A. hopsoni* (authors unpublished data).

*Notopedaria scarpensis* Matthews had not been recorded south of Dorrigo, northern New South Wales (Matthews 1976) and is the first member of the Coprini thus recorded from this region.

Of the seventeen species of dung beetles, including both open habitat and dense forest species, recorded by Matthews (1972 and 1974) from the Barrington Tops and Comboyne only *Lepanus politus* (Carter) was not encountered.

The presence of *Aptenocanthon hopsoni, Amphistomus primonactus* and *Notopedaria scarpensis* at applecore baited pit-traps represent the first recorded indications of carpophagy (fruit eating) in the Australian Scarabaeini and Coprini. These records were obtained during trap nights in which a range of simultaneously offered bait types (eg. carrion, fungi and excrement) were available to the beetles.

**Acknowledgments**

We wish to express our thanks to the New South Wales National Parks and Wildlife Service and the Forestry Commission of New South Wales for permitting work to be undertaken in areas under their care. Mr T. Weir and Dr E. B. Britton, C.S.I.R.O, Canberra and Dr E. G. Matthews of the South Australian Museum kindly assisted with a number of difficult species determinations. Mr G. King, Forestry Commission, and Mr M. Dodkin, N.P.W.S., gave helpful backgrounding on vegetation types.

**REFERENCES**

Matthews, E. G., 1972. A revision of the Scarabaeine dung beetles of Australia. 1. Tribe Onthophagini. *Aust. J. Zool., Suppl. Ser. 9:1-330.*

Matthews, E. G., 1974. A revision of the Scarabaeine dung beetles of Australia. 2. Tribe Scarabaeini. *Aust. J. Zool., Suppl. Ser.* 24:1-221

Matthews, E.G., 1976. A revision of the Scarabaeine dung beetles of Australia. 3. Tribe Coprini. *Aust. J. Zool., Suppl. Ser.* 38:1-52.

Storey, R. I., 1977. Six new species of *Onthophagus* Latreille (Coleoptera:Scarabaeidae) from Australia. *J. Aust. ent. Soc.*, 16:313-320

Williams, G. A. and Williams, T., 1982. A survey of the Aphodiinae, Hybosorinae and Scarabaeinae (Coleoptera: Scarabaeidae) from small wet forests of coastal New South Wales, Part 1: Nowra to Newcastle. *Aust. ent. Mag. 9:42-48.*

Table 1. List of study sites and species taken at each.
(Dates of collection are followed by figures in parenthesis indicating the number of specimens taken.)

A. Allyn River Forest Park, Chichester State Forest, N.W. of Dungog. River restricted subtropical rain forest, brown loam soil.
*Aphodius* sp. 1.xi.1978, (1), at faeces.

*Ataenius semicaecus* Macleay? 23.xii.1978(1), at light.
*Liparochrus fossulatus* Westwood, 25.xii.1978, (2), at faeces.
*Amphistomus speculifer* Matthews. 25.xii.1978, (1), at faeces. Also in *Nothofagus* forest at Mt. Allyn Forest Park.
*Aptenocanthon hopsoni* (Carter). 1.xi.1978, (1); 23.xii.1978, (8), at faeces. Also in *Nothofagus* forest at Mt. Allyn Forest Park.
*Diorygopyx asciculifer* Matthews. 1.xi.1978, (1); 23.xii.1978, (3), at faeces and under logs, also in adjoining dry sclerophyll forest.
*Onthophagus arrilla* Matthews. 1.xi.1978, (2), at faeces.
*Onthophagus capella* Kirby. 1.xi.1978, (1), at light.
*Onthophagus chepara* Matthews. 23.xii.1978, (1), at light.
*Onthophagus macrocephalus* Kirby. 1.xi.1978, (1); 23.xii.1978, (1), at faeces, also in adjoining dry sclerophyll forest.
*Onthophagus sydneyensis* Blackburn. 1.xi.1978, (3), at faeces.

B. Copeland Tops State Forest (Fourth wet gully from western base of ascent road), W.N.W. of Gloucester. Dry type rainforest gully, brown loam soil, medium density leaf litter and low herb cover.
*Aphodius* sp. near *insignior* Blackburn. 6.i.1982, (3); 3.ii.1982, (4), at faeces.
*Liparochrus silphoides* Harold. 6.i.1982, (1); 3.ii.1982, (3), at faeces and under logs.
*Diorygopyx asciculifer* Matthews. 6.i.1982, (9); 3.ii.1982, (28), at faeces.
*Onthophagus kiambram* Storey. 3.ii.1982, (5), at faeces.
*Onthophagus neostenocerus* Goidanich. 3.ii.1982, (1), at faeces.
*Onthophagus* sp. near *nurubuan* Matthews. 6.i.1982, (1), at faeces.
*Onthophagus sydneyensis* Blackburn. 6.i.1982, (1), at faeces.

C. Mitchell's Creek Rest Area. N.E. section, Barrington Tops State Forest, W.N.W. of Gloucester. Warm temperate-subtropical rainforest gully. Brown loam soil with light leaf litter cover.
*Aphodius* sp. near *insignior* Blackburn. 6.i.1982, (16); 3.ii.1982, (35), at faeces.
*Liparochrus silphoides* Harold. 6.i.1982, (3); 3.ii.1982, (9), at faeces.
*Amphistomus speculifer* Matthews. 6.i.1982, (3); 3.ii.1982, (11), at faeces.
*Aptenocanthon hopsoni* (Carter). 6.i.1982, (6); 3.ii.1982, (2), at faeces.
*Diorygopyx asciculifer* Matthews. 6.i.1982, (10); 3.ii.1982, (34), at faeces.
*Onthophagus bornemisszai* Matthews. 6.i.1982, (1), under cow manure on rainforest margin.
*Onthophagus kiambram* Storey. 6.i.1982, (1); 3.ii.1982, (6), at faeces.
*Onthophagus* sp. near *nurubuan* Matthews. 6.i.1982, (1), at faeces.
*Onthophagus pugnax* Harold. 3.ii.1982, (1), at faeces.
*Onthophagus sydneyensis* Blackburn. 6.i.1982, (6), at faeces.

D. Moppy Lookout Rest Area. Barrington Tops State Forest. W.N.W. of Gloucester. Antarctic beech (*Nothofagus*) rainforest. Red-brown loam soil with light leaf litter cover.
*Liparochrus silphoides* Harold. 20.i.1981, (2); 6.i.1982, (4); 3.ii.1982, (23), at faeces, applecores, under logs and at u/v light on forest floor.
*Aptenocanthon hopsoni* (Carter). 20.i.1981, (15); 6.i.1982, (approx. 90); 3.ii.1982, (approx. 110), at faeces, bird droppings, rotting agaric fungi, fresh fish flesh, chicken bones, cow manure (as bait), marsupial droppings, applecores and under logs.
*Onthophagus fuliginosus* Erichson. 20.i.1981, (3); 6.i.1982, (5), at faeces.
*Onthophagus longipes* Paulian. 6.i.1982, (3), at faeces.
*Onthophagus* sp. (new species). 20.i.1981, (1), at faeces.

E. Dingo Tops Forest Park. Dingo State Forest N.W. of Wingham. (2 sites)
1. Wet sclerophyll forest immediately to the south and southeast of the park.
2. Temperate-subtropical rainforest immediately to the west and east of the park.
1. Wet sclerophyll forest. Red-brown clay loam.
*Aphodius* sp. near *insignior* Blackburn. 26.ii.1981, (4), at faeces.
*Liparochrus silphoides* Harold. 26.ii.1981, (6), at faeces and under logs.
*Amphistomus primonactus* Matthews. 26.ii.1981, (12), at faeces.
*Amphistomus speculifer* Matthews. 26.ii.1981, (22), 6.x.1981, (3), at faeces and chicken bones.
*Aptenocanthon hopsoni* (Carter). 26.ii.1981, (31), at faeces.
*Diorygopyx asciculifer* Matthews. 16.ii.1981, (34); 6.x.1981, (68), at faeces and chicken bones.
*Notopedaria scarpensis* Matthews. 26.x.1981, (4), at faeces and u/v light on forest floor.
*Onthophagus kiambram* Storey. 16.ii.1981, (3); 6.x.1981, (1), at faeces and chicken bones.
*Onthophagus longipes* Paulian. 26.ii.1981, (1), at faeces.
*Onthophagus pugnax* Harold. 26.ii.1981, (3), at faeces.
*Onthophagus sydneyensis* Blackburn. 26.ii.1981, (1), 6.x.1981, (1), at faeces and wallaby droppings.

*the elytra of a species near *Liparochrus fossulatus* Westwood were found at this site on 26.ii.1981.

2. Temperate-subtropical rainforest complex. Red-brown loam soil, medium density leaf litter.
*Aphodius* sp. near *insignior* Blackburn. 26.ii.1981, (2), at faeces.
*Liparochrus silphoides* Harold. 26.ii.1981, (2), at faeces.
*Amphistomus primonactus* Matthews. 26.ii.1981, (13); 8.x.1981, (3), at faeces.
*Amphistomus speculifer* Matthews. 26.ii.1981, (4); 8.x.1981, (3), at faeces and chicken bones.
*Aptenocanthon hopsoni* (Carter). 26.ii.1981, (8); 8.x.1981, (1), at faeces.
*Aulacopris maximus* Matthews. 26.ii.1981, (2), at faeces.
*Diorygopyx asciculifer* Matthews. 26.ii.1981, (5); 8.x.1981, (4), at faeces.
*Notopedaria scarpensis* Matthews. 26.ii.1981, (6), at faeces.
*Onthophagus fuliginosus* Erichson. 8.x.1981, (4), at faeces.
*Onthophagus kiambram* Storey. 26.ii.1981, (11); 8.x.1981, (4), at faeces and chicken bones.
*Onthophagus* sp. near *macrocephalus* Kirby. 16.ii.1981, (1); 8.x.1981, (1), at faeces.
*Onthophagus pugnax* Harold. 26.ii.1981, (2), at faeces.
*Onthophagus sydneyensis* Blackburn. 26.ii.1981, (1), at faeces.

F. Boorganna Nature Reserve. S.W. of Comboyne. Subtropical rainforest, red-brown loam soil with medium to heavy leaf litter cover.
*Aphodius* sp. near *insignior* Blackburn. 7.i.1981, (21), at faeces.
*Liparochrus silphoides* Harold. 7.i.1981, (8), at faeces.
*Amphistomus primonactus* Matthews. 7.i.1981, (6); 16.x.1981, (41), at faeces, mushrooms, fresh liver and applecores.
*Amphistomus speculifer* Matthews. 16.x.1981, (1), at faeces.
*Aptenocanthon hopsoni* (Carter). 7.i.1981, (approx. 40); 16.x.1981, (18), at faeces, mushrooms and fresh liver.
*Cephalodesmius armiger* Westwood. 7.i.1981, (2); 16.x.1981, (2), at faeces, mushrooms and fresh liver.
*Diorygopyx incrassatus* Matthews. 7.i.1981, (2), at faeces.
*Notopedaria scarpensis* Matthews. 16.x.1981, (2), at faeces and applecores.
*Onthophagus capella* Kirby. 7.i.1981, (1), at faeces.
*Onthophagus kiambram* Storey. 7.i.1981, (9), at faeces.
*Onthophagus sydneyensis* Blackburn. 7.i.1981, (11), at faeces.

Table 2. Systematic summary of species encountered.
(Letters indicate study sites; where indicated, specimens lodged in Australian National Insect Collection, Canberra)
Family Scarabaeidae.
Subfamily Hybosorinae.
*Liparochrus fossulatus* Westwood. A, E(1).
*Liparochrus silphoides* Harold. B, C, D, E(1), E(2), F. Specimens in A.N.I.C.
Subfamily Aphodiinae.
*Aphodius* sp. A.
*Aphodius* sp. near *insignior* Blackburn. B, C, E(1), E(2), F. Specimens in A.N.I.C.
*Ataenius semicaecus* Macleay ? A.
Subfamily Scarabaeinae.
Tribe Onthophagini.
*Onthophagus arrilla* Matthews. A. Specimens in A.N.I.C.
*Onthophagus bornemisszai* Matthews. C.
*Onthophagus capella* Kirby. A, F.
*Onthophagus chepara* Matthews. A.
*Onthophagus fuliginosus* Erichson. D., E(2). Specimens in A.N.I.C.
*Onthophagus kiambram Storey. B., C., E(1) E(2),* F. Specimens in A.N.I.C.
*Onthophagus macrocephalus* Kirby. A.
*Onthophagus* sp. near *macrocephalus* Kirby. E(2). Specimen in A.N.I.C.
*Onthophagus neostenocerus Goidanich.* B.
*Onthophagus* sp. near *nurubuan* Matthews. B, C. Specimens in A.N.I.C.
*Onthophagus pugnax* Harold. C, E(1), E(2). Specimen in A.N.I.C.
*Onthophagus longipes* Paulian, D, E(1). Specimen in A.N.I.C.
*Onthophagus sydneyensis* Blackburn. A, B, C, E(1), E(2), F. Specimen in A.N.I.C.
*Onthophagus* sp. (*capella* sp. group ?), new species, D. Specimen in A.N.I.C.
Tribe Scarabaeini.
*Amphistomus primonactus* Matthews. E(1), E(2), F. Specimens in A.N.I.C.
*Amphistomus speculifer* Matthews. A, C, E(1), E(2), F. Specimens in A.N.I.C.
*Aptenocanthon hopsoni* (Carter). A, C, D, E(1), E(2), F. Specimens in A.N.I.C.

*Aulacopris maximus* Matthews. E(2), F. Specimen in A.N.I.C.
*Cephalodesmius armiger* Westwood. F. Specimen in A.N.I.C.
*Diorygopyx asciculifer* Matthews. A, B, C, E(1), E(2). Specimens in A.N.I.C.
*Diorygopyx incrassatus* Matthews. F. Specimen in A.N.I.C.
Tribe Coprini.
*Notopedaria scarpensis* Matthews. E(1), E(2), F. Specimen in A.N.I.C.

---

# Report of Excursion to Bendigo — August 28-29th, 1982, for the Early Springtime Get together of the Victorian Field Naturalists Clubs Association

On Saturday, August 28th, a bus-load of Melbourne members met 10 private cars with members from 13 different country Field Naturalists Clubs, at the Regional Veterinary Laboratories, Department of Agriculture, Epsom, some 5.6 km. from the Bendigo fountain.

The initial excursion was to the Whipstick and was led by Mr. Frank Robbins to see the profusion of yellow wattle, *Acacia williamsonii* which was flowering over many square kilometres of very dry whipstick scrub. Bendigo is involved in this year's severe drought, but in spite of this, some small specimens of *Caladenia carnea* (Pink Fingers), *C. caerulea* (Blue Caladenia) and *Diuris maculata* (Leopard Orchid) were found. A tour was made past a Eucalyptus Distillery to an area where three mallees flourished side by side:-

*Eucalyptus froggatii* (Kamarooka Mallee)
*Eucalyptus viridis* (Green Mallee)
*Eucalyptus polybractea* (Blue Mallee)

In the evening a short general meeting was held at the Regional Veterinary Laboratories meeting room chaired by the President of the V.F.N.C.A., Mr. Alan Monger of Benalla. Approximately 65 members from 13 Field Naturalists Clubs attended — these included:-

Albury-Wodonga, Bairnsdale, Benalla, Bendigo, Castlemaine, Creswick, Norfolk Nats. England, Mid-Murray, Montmorency, Upper Goulburn, Melbourne, Warragul, North-east F.N.C

Mr. William Perry of Bendigo received a certificate of honorary membership of the Victorian Field Naturalists Clubs presented by the President, Miss Wendy Clark, who later made an appeal for help with an orchid survey in the State. At the conclusion of the meeting — Mr. Laurie Leeson, Honorary Secretary of the Bendigo Club introduced Mr. Bill Flentje who enthralled the audience with his coloured slides of local birds accompanied by their calls on tape. The Bendigo ladies provided a lavish sit-down supper at the conclusion of the meeting.

Sunday August 29th proved to be the hottest August day on record, the thermometer reaching over 26°C, the first excursion was to a lake on the Bendigo Sewerage farm where numerous water birds were seen, some 53 different birds were recorded during the two days of the excursion.

Around mid-morning a visit was made to Salomons Gully Nature Reserve where the fairy wax-flower *(Eriostemon verrucosus)* was almost in full flower — a walk around the Nature Trail was led by Mr. Jim Brown.

After a picnic lunch, the participants returned home to their respective areas of Victoria, convinced that these twice yearly get-together meetings were of value not only for social reasons, but for keeping the entire Victorian Field Naturalists Clubs in communication on matters of conservation and ecology, increasing naturalist knowlege in many areas, and alerting interested persons to potential danger areas, to assist them in their efforts to stem the tides of wanton destruction of the environment of the Australian bush.

—E. K. Turner

# Montmorency Field Naturalist Club

OFFICE BEARERS, 1982:

| | |
|---|---|
| President | David Peebles |
| Vice-President | Ross Osborne |
| Treasurer | Robert Braby |
| Secretary | Elaine Braby |
| Librarian | Gay Bell |
| Excursions | Don Clark |
| Exhibits | Ian Endersby |

1982 has been a year of continued prosperity for the Club with a total membership of 18 families and 6 singles. Attendances at meetings have been very good, averaging 30 to 40, but attendances at excursions have been rather low. Subscriptions remained at $5 per family and $3 single.

**Meetings and Subjects held in 1982:**

| | |
|---|---|
| February | "Kinglake National Park" by Phil O'Connor, Park Ranger |
| March | Annual General Meeting. Members' slide night. |
| April | "Sand Dune Stabilisation" by Paul Fitzsimons, Soil Conservation Authority. |
| May | "Montmorency — 20 years ago" by Bob Winters, Education Officer, Healesville Sanctuary. |
| June | "Restoration of Merri Creek" by Alan Thomson, Pascoe Vale Naturalist Club. |
| July | "Reptiles of South Africa" by Dave Clode. |
| August | "Characteristics and changes in Victorian habitats" by Leon Costermans. |
| September | "Butterflies" by Ross Field, entomologist, Lands Department. |
| October | "Geology of Bacchus Marsh" by Ian Hawkins, geologist, Melbourne State College. |
| November | "Earthquakes" by Gary Gibson, Seismologist, Phillip Institute of Technology. |
| December | "Reptiles" by Fritz Maaten, proprietor of Melbourne Reptile and Fauna Park. |

**Exhibits:**

Members, particularly the juniors, regularly brought interesting exhibits to the meetings. The best exhibits were the butterfly collection shown in September. Also, in the warmer weather, we frequently had lizards and snakes brought in.

**Excursions:**

| | |
|---|---|
| March | Kurth Kiln, Gembrook State Forest. |
| May | Coranderk, Healesville. |
| June | Kinglake National Park. |
| August 15 | Banyule Flats Reserve. |
| August 22 | You Yangs. |
| September | Weekend Camp, Whipstick Forest. |
| October | Bacchus Marsh. |
| December | Christmas Barbecue. |

The most popular excursion was the fossil-hunting trip to Bacchus Marsh. This was led by geologist, Ian Hawkins. First we visited the Maddingley Coal Mine where we found tree fossils of the Tertiary Period. Then we travelled to the top of the Werribee Gorge where we found an abundance of Graptolite fossils in the Ordovician shale.

**Field Naturalists Clubs Association:**

One of our members attended the weekend Get-together at Bendigo on August 28-29.

**Displays:**

A display of bird posters and nests was featured at the Eltham Library during Eltham Festival Week in October.

**Enquiries:** Secretary, 439 9015.

# Notes on the Capture Period of the Tiger Quoll (*Dasyurus maculatus*) in Victoria

BY IAN MANSERGH*

**Abstract**

Over 90% of Tiger Quolls (*Dasyurus maculatus*) captured in Victoria are male and over 80% of these are taken between May-August. Capture appears to be related to an increase in activity of the males during the breeding season as is the case in other *Dasyurus* sp.

**Introduction**

The Tiger Quoll or Tiger Cat (*Dasyurus maculatus*) is the largest marsupial carnivore surviving on mainland Australia and is a rare species in Victoria. At present the species is not the subject of a wide range of research effort (e.g. Archer 1982) although Mansergh (in press) describes, from the historical record, the distribution, abundance and status of the species in Victoria. Since more information about this species has been called for (Ahern 1982), data derived from Victorian records providing the season of capture and an interesting propensity for males of the species to be captured are presented below.

**Methods**

Records of the Tiger Quoll in Victoria, made before December 1981, were extracted from the literature (175 references), records of the Fisheries and Wildlife Division, the depository museums of each Australian state, the British Museum, the Department of Crown Lands and Survey and the Royal Zoological Gardens (Melbourne). These records were examined for references to captured animals (i.e. sightings were excluded), the sex of the animals and period of capture was noted from these records.

**Results**

Two hundred and forty records of the Tiger Quoll were examined and 52% of the records were of captured animals, of these approximately two-thirds were trapped, less than 10% were shot or poisoned near farm buildings whilst the remainder were taken by unspecified means. One hundred and four capture records gave the month of capture and 95% of these recorded the sex of the captured animal (Fig. 1), whilst 20 records of either male or unsexed animals provided the season of capture only. These data are presented in Figure 1, which also shows the mating season of the species in Victoria (Fleay 1940).

**Discussion**

Data presented in Figure 1 show that there is a propensity for captured Tiger Quolls to be male and to be taken between May-August. The sex ratio (1 female:11 males) of captured Tiger Quolls is not explained by the probable sex ratio of the population, i.e. Fleay (1940) noted a ratio of captive bred lit-

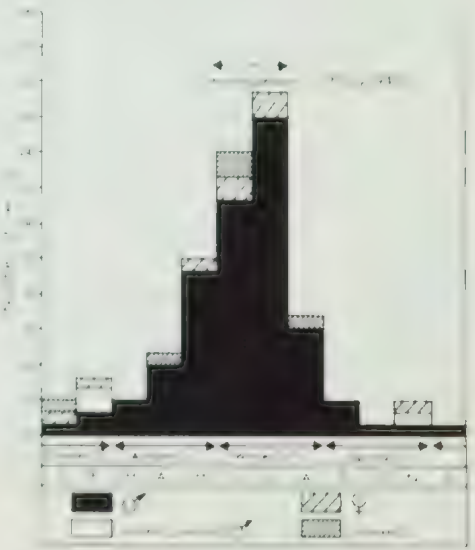


Fig. 1. Month of capture and sex of Tiger Quolls (*D. maculatus*) taken in Victoria.

*Arthur Rylah Institute for Environmental Research, 123 Brown Street, Heidelberg, Victoria, 3084

ters of 1:1.5 whilst Settle (1978) noted 1:1. The sex ratio of the captured population and the period of capture suggests that capture is related to an increased activity of males during the breeding season. A higher trapping success for the male Northern Quoll (*D. hallucatus*) during the breeding season has been noted (Begg 1981) whilst Godsell (1982) recorded an increase in the number of transient males during the breeding season of the Eastern Quoll (*D. viverrinus*).

**Acknowledgements**

I would like to thank the curators of each state depository museum for providing all Victorian records of the Tiger Quoll. A. McShane, (FWD) drafted the Figure.

REFERENCES

Ahern, L. A. 1982. Threatened wildlife in Victoria and issues related to its conservation. *Fish. Wildl. Pap.* 27.

Archer, M. (ed) 1982. *Carnivorous marsupials*. 2v. Royal Zoological Society of New South Wales, Mosman.

Begg, R. J., 1981. The small mammals of Little Nourlunyie Rock, N. T. III. Ecology of *Dasyurus hallucatus*, the Northern Quoll (Marsupialia: Dasyuridae) *Aust. Wildl. Res.* 8: 73-85.

Heay, D., 1940. Breeding of the Tiger Cat. *Victorian Nat.* 56: 159-163.

Godsell, J., 1982. The population ecology of the Eastern Quoll, *Dasyurus viverrinus* (Dasyuridae: Marsupialia), in southern Tasmania. In ARCHER, M. (ed.), 1982. *Carnivorous marsupiala* v.1: 199-207. Royal Zoological Society of New South Wales, Mosman

Mansergh, I. M. (in press). The status, distribution and abundance of *Dasyurus maculatus* (Tiger Quoll) in Australia with particular reference to Victoria. *Aust. Zool.*

Settle, G. A. (1978). The quididity of Tiger Quolls. *Austn. Natural Hist. 19*: 165-169.

# The Derrinal Permian Glacial Valley Part 3

BY FRANK ROBBINS

**The Moorabbee Cliffs Area** — see Fig 7 and Fig 2

The best time to visit this interesting area is when the lake-level is at its lowest in autumn or winter, before the heavy rains have started. Access is by sealed road to Moorabbee Caravan Park. Toilets and picnic tables are available.

The lowest levels reached to date were 185.5m. (608.63 ft) on 3.5.1968 and 186.7m (612.5 ft) A.S.L. on 16.5.78. Erosion by the waves since filling of the reservoir in 1963 has uncovered a remarkable complex of glacial tillite, conglomerate, sandstone, erratics etc. below the full supply level (F.S.L.) or 194.2m or 637 ft A.S.L. The best places to inspect these are along the Pt Patterson (Beacon Pt) beach, or the Moorabbee Bluff, the steep cliff area below the "round-about" or toilets, take care — it is very dangerous in places.

The *main features* in this Moorabbee area are:-

(a) a thick flat-lying glacial sandstone occupying most of the grassed area above F.S.L.

*Continued from 99:205.*

*81 MacKenzie St., Bendigo, 3550.

(b) an upper tillite member only evident at the "effluent dam" on the crest, and the cuttings on the access road.

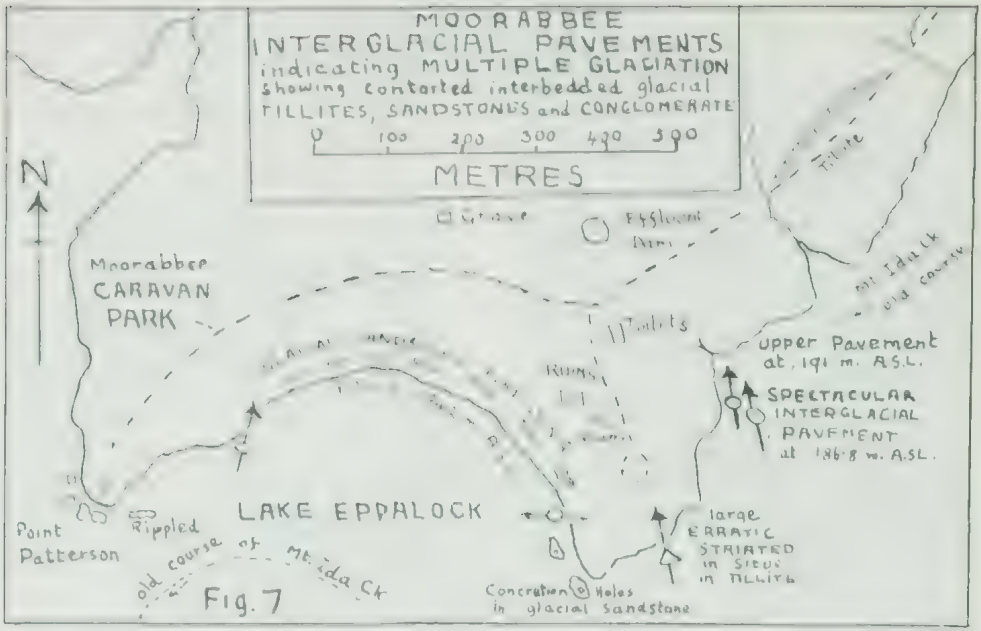
(c) a complex much *distorted glacial series* below F.S.L.

(d) four interglacial pavements within (a) pointing to at least three advances and retreats of the ice, i.e. multiple advance and retreat.

(e) *minor features*, such as boulder pavement, erratics striated in situ, rippled sandstone, strange "pot-hole concretionary" structures.

(f) Patterson home ruins and grave dated 1852.

*General structure* and interpretation — rather difficult to unravel, but it seems reasonable to conclude this area including the Farley's eastern area could be an overdeepened section of the glacial valley, and from time to time the terminal or end-moraine of the Permian ice flow i.e. its furthest northern reach. There must be at least 60m (200 ft) thickness of beds, which includes flat-lying glacial sandstone. This was quarried to build the Patterson home — the "ruins" now protected by a high wire fence. The nearby Patterson grave with its recently restored marble headstone gives a date of




1852. To the north would be the out-wash plain or possibly a Permian sea, although no marine evidence is known to date. All glacial pavements on basement rock (except one — Longs Rock — see Fig 2) occur in the southern sector of the valley. The sandstone would have been deposited from melt-water in a glacial lake or swamp or out-wash condition, and most likely such conditions could occur in the vicinity or south side of the moraine. This suggests that the Wild Duck-Mt Ida Creek system which has a huge catchment area, and which formerly existed further south as indicated by the Tertiary high-level gravels (see Fig. 2), has removed an enormous thickness of glacial beds in the area now occupied by the lake. In doing this, it has migrated northwards, thus accounting for the cliffs of the Moorabbee section, and the steep rise in profile all along the north bank of the Mt. Ida Ck., as contrasted with the gentle rise on the south side.

The *complex interbedded contorted tillites, conglomerates,* and *sandstones* with interglacial pavements in the lowest section below E.S.L., would be difficult to explain unless we invoked multiple glaciation, retreat and advance of the ice, pushing or overriding previous beds deposited by ice or melt-water, buried ice under horizontal beds taking perhaps thousands of years to melt and disturb dips etc. It is certainly well worth while to walk around the edge of the lake at low level time to see the remarkable sections.

Phil O'Brien of Melbourne University has spent some time studying these most interesting beach exposures, but I have not seen his conclusions yet.

Of the observed formations here, the most striking are *two interglacial pavements,* one above the other, separated by about 3.7 m. (12 ft.), the upper one (called Frakes Pavement — Dr. L. A. Frakes on 23.3.75) at about 192 m. (630 ft.) A.S.L., and the lower one (Wilkinsons Pavement — Mar. 1977) at about 187 m. (614 ft.) A.S.L. The *Upper Pavement* is on a fairly hard coarse glacial sandstone (indurated but softer below the skin) surface about 2.3 x 0.9 m. (7.5 x 3 ft.) in area on a face which sloped 18° to 26° easterly towards 71°T, and then more steeply 40° to 50° down into the water. The scratches were up to 2.3 m. (7.5 ft.) long running slightly down-hill to the north at 6° in the direction 350°T, which agrees closely with our generally accepted direction of the ice. Three strange lines of small transverse ridges parallel to the scratches reminded me of "chatter marks". Each little "transverse ridge" was somewhat "wavy" puzzling us as to how such little raised characters could have been produced. Higher up below E.S.L., this sandstone surface had a covering of pebbly glacial conglomerate, which obviously was deposited

from the advancing ice responsible for producing the upper pavement scratches. Being just below F.S.L., the waves had removed enough conglomerate to reveal the scratches on the underlying sandstone. The texture of this glacial sandstone from the surface downwards gradually changed to a coarse glacial conglomerate resting on the *Lower Interglacial Pavement* (Wilkinson's Pavement). This was a remarkable discovery by Eric Wilkinson in March 1977. Instead of the usual scratches, there were parallel grooves 25 to 75 mm. (1″ to 3″) apart, and up to 20 mm. (¾″) depth obviously produced by the motion of large rounded pebbles perhaps embedded in the bottom of ice advancing over a comparatively softer glacially deposited sandstone or even frozen sand under perma-frost conditions. The grooves were aligned at 338°-340°T at the south end curving round slightly to 343°-344°T at northern end some 15 m. (50 ft.) further on. The grooved section resembles a huge platform, sloping at 6° to 12° downwards towards 70°T, although the ice was really moving slightly uphill at 2° obliquely into the cliffs. The eastern pavement edge ends abruptly with an almost vertical sandstone cliff down into deep water some 6 m. (20 ft.) below close to where the Mt. Ida-Wild Duck Ck. had been eroding away the Moorabbee Cliffs for unknown ages past. (see Fig. 7) i.e. this pavement once extended far out into the area where the lake is now. Likewise, this pavement must extend an unknown distance into the cliffs under a cover of glacial conglomerate, which, being unconsolidated, is continually being loosened and washed over-

Plate 1. Surface of Wilkinsons Interglacial pavement with embedded clasts and overlying glacial conglomerate. Photo. T. Patullo.

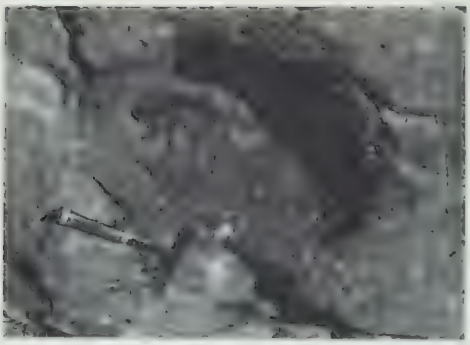


Plate 2. A strange hemispherical "concretion?" hole often seen in the glacial sandstone of Moorabbee area.

board, thus widening the platform, when the lake-level drops below 189 m. (620 ft.) A.S.L., which does not often happen. At the S.W. end, the platform has been greatly uncovered of its conglomerate, and slopes upward more steeply (say 30°) for a further 9 m. (30 ft.) or more. The glacial groove character here gives way to a smoother striated surface, due to perhaps having been exposed long ago and perhaps was more strongly lithified.

*Other interesting features* of the pavement are:-

(a) a *light coloured incrustation* in the grooves, which we thought might be calcrete, failed to give gas with a hydrochloric acid test. This would indicate a silcrete coating in the grooves. This contrasts with the calcrete deposits I had seen on the famous Irai Pavement in India in the land of the Gonds discovered about 1872. Of course, this large pavement was on late Pre-cambrian limestone. Hence, the origin of the name Gondwanaland. Gondwana in Gond language means 'land of the Gonds'. It was the first proof that the widespread Indian Talchir boulder beds of striated and facetted rocks were really glacial erratics of a great upper Palaeozoic Ice Age. Very soon, more glacial pavements were discovered in S. Australia (Halletts Cove — 1877), Dunns Rock — 1892 at Knowsley, Bacchus Marsh, and S. Africa (Dwyka).

(b) *Two pebbles* or clasts obviously originally in the bottom of the moving ice, had become detatched and then dragged or rolled along a furrow in the sandstone below for a short distance before finally becoming stuck in the sandstone. One of them, having detached with its longer axis parallel to the ice movement, had rolled sideways till its axis was at right angles to the ice movement, then rolled forward in a big furrow till it finally stuck firmly. I forgot to examine these two to see if they were finely striated in the same direction as the other grooves.

(c) *Other clasts* — (3) — of hard metasandstone up to 15 cm. (6") with fine striations parallel to the grooves were firmly embedded in the lower platform, and three more striated at 335°-337°T were further up near the S.W. section of the pavement. The term *boulder pavement* is used where a number of embedded erratics are all striated on top parallel to the ice movement.

(d) Puzzling *hemispherical "concretionary potholes"* — these strange formations — three in the lower platform and four in the upper S.W. section up to 51 cm. (20") diameter. Two of them had a rounded striated quartzite clast in the dark honeycomb like "carbonaceous"? centre. Similar structures are seen on top of the large sandstone blocks at the S.E. corner below the roundabout, also on the beaches near Pt. Patterson and at Crimea Cove. I have not seen any mention or explanation of these in the glacial literature nor on inquiry in New Zealand at the 5th Gondwana meeting.

*Two other interglacial pavements* — one near Pt. Patterson is about 2.3 m. (7.5 ft.) long and grooved at 008°T — insufficient area to judge whether it is a remnant of a large ice advance, or a minor dislocation of beds. Another sandstone still in situ and finely striated east-west, needs an explanation, because it conflicts with the other evidence of N.S. ice movement.

*Rippled glacial sandstone* — near Pt. Patterson large broken rock — tumbled over on beach — shows in vertical section and very striking surface exposure the ripples produced by melt-water running over a sandy bottom. It is possible to infer the direction of the flow of water, but not if the rock has tumbled over as this one has.

*Erratics* — there is an abundance of rounded facetted and striated sedimentary, igneous and metamorphic rocks strewn along the beaches. One large rounded grey quartzite (see Fig. 7) is embedded in tillite and striated at 340°T. Obviously, it was striated in situ, indicating that advancing ice was over-riding the other already dislocated formations. This would make a total of eight erratics or erratic groups striated in situ in our area.

(Continued on page 39)

# Observations on the Genus *Alcinous* Deyrolle (Coleoptera:Buprestidae)

BY GEOFF WILLIAMS*

**Abstract**

Near Taree, New South Wales, both *Alcinous fossicollis* (Kerremans) and *A. nodosus* Kerremans were found to be restricted primarily to the Large-leaved, or Molucca bramble, *Rubus hillii* (Rosaceae) with one record of *A. nodosus* from the Green-leaved bramble or Bush lawyer, *R. moorei*. The two buprestid species were restricted to plants growing on or near forest edges and neither species was found on the introduced blackberry *Rubus vulgaris* in the area. *Alcinous* spp. were not observed on the native pinnate-leaved *R. rosifolius*. Little information has been recorded on the two species of *Alcinous* occurring in Australia but the genus appears to be specific to native *Rubus* species.

---

In a study of the phytophagous insect fauna associated with *Rubus* spp. in Victoria, Bruzzese (1980) observed adult *Alcinous fossicollis* (Kerremans) on rare occasions on the leaves and canes of the endemic Small-leaf bramble, *Rubus parvifolius* L. The beetles were not found on introduced *Rubus* spp. even when these plants grew side by side with *R. parvifolius*. Bruzzese considered this was reasonable evidence for host specificity.

This conclusion has been verified by observations made both in the spring and summer of 1980-81 and 1981-82 in a variety of habitats at Lansdowne, near Taree, New South Wales. In addition observations have been extended to a second species, *Alcinous nodosus* Kerremans (Fig. 1.).

Little information has been recorded on the Australian species of *Alcinous*. Except for references to *A. fossicollis* by Bruzzese (1980) the biology and behaviour of *Alcinous* is otherwise unrecorded. Carter (1923) briefly notes that the genus is found in the coastal "brush" (rainforest) areas of the east coast where it "chiefly occurs on *Acacia* foliage". His statement that alcinous is chiefly found on *Acacia* has not been substantiated and is considered by the present author to have been erroneous.

Native brambles and raspberries of the genus *Rubus* occur widely in Australia (Galbraith 1977) with the majority of species being restricted to the wetter forest types of the east coast from north Queensland to Victoria (Williams 1980). An examination of locality labels for *Alcinous* specimens in the Australian National Insect Collection, Canberra, the Australian Museum, Sydney, and a number of private collections indicate a sympatric distribution for both species from north Queensland to Victoria. On the east coast both *A. fossicollis* and *A. nodosus* appear restricted to high rainfall areas and are well within the known distribution of native *Rubus* spp.

The Large-leaved, or Molucca bramble, *Rubus hillii* F. Muell. is found as far south as eastern Victoria (Bruzzese

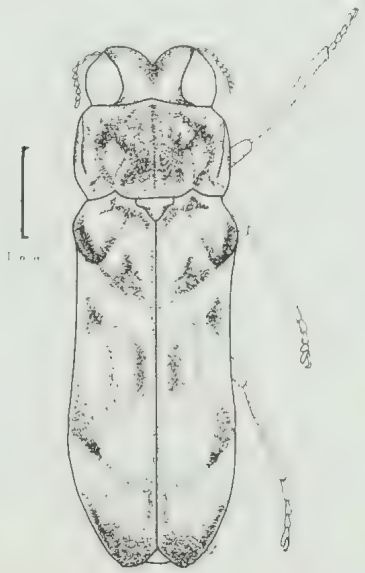


Fig. 1 *Alcinous nodosus*.

*Newby's Lane, Lansdowne via Taree, N.S.W. 2430.

1980). In the vicinity of Lansdowne it occurs locally on the edges of wet sclerophyll forest and more commonly gully rainforest where it quickly establishes in disturbed and regenerating areas. Less frequently the species is associated with clumps of lantana in lightly timbered pasture established on old wet forest sites.

The introduced Blackberry, *Rubus vulgaris* Weihe et Nees, also occurs in cleared areas adjacent to, or within, wet forest types and so may be found growing together with *R. hillii*. Neither *A. fossicollis* nor *A. nodosus* was observed on introduced *Rubus* or on *R. hillii* where this species was growing in pasture. The beetles were most commonly encountered during spring but a few isolated individuals could be found until late January.

Of some 30 *R. hillii* plants associated with wet forests at Lansdowne, fewer than 13 yielded beetles of either species at any one time, and fewer than five plants carried more than two individuals of either species. Progressively the adult beetles moved from plant to plant so that by the end of summer most had been attacked. No plants appeared to have been adversely affected by the beetles and both attacked and unattacked *R. hillii* exhibited comparably healthy growth by mid-autumn.

During the day *A. fossicollis* beetles (Fig. 3) were observed at rest along the main central leaf vein or at the base of the lamina and in such a situation small clumps of faeces were normally associated with them. The beetles moved out radially from this dorsal resting position to feed on the leaf surface where they caused characteristic pale blotches (Fig. 2). The beetles did not eat completely through the leaf but in most cases the remaining leaf tissue rotted away, leaving clusters of irregular holes 1-4 mm in diameter. The beetles generally were inactive on cloudy days, and at night moved to positions adjacent to the edges of the ventral leaf surface. Copulation took place on the dorsal leaf surface. I have been unable to attain any information on larval feeding.

The larger but less common *A. Nodosus* was found within the same

Fig. 2 Silhouette of *Rubus hillii* leaflets showing characteristic patterns of feeding blotches made by *Aleinous fossicollis*

range of habitats as *A. fossicollis*. Whereas *A. fossicollis* fed mostly within the central section of the leaf, *A. nodosus* fed only on the leaf margins where it left irregular excisions indistinguishable from those caused by a number of other insects. Copulation occurs on the leaf surface of *R. hillii* and the females deposit their eggs on the bramble canes. The larvae feed upon the pithy interior and pupate within the canes.

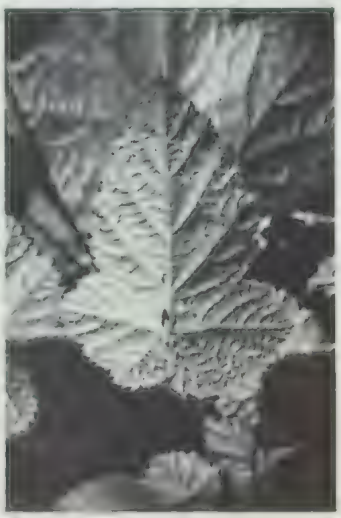


Fig. 3 *Aleinous fossicollis* on *Rubus hillii*.

The apparent partitioning of feeding niches on the leaves of *R. hillii* possibly allows the two species to co-exist without competition. Although aggression was not observed between the two species, males of *A. fossicollis* grappled furiously upon meeting, in many cases falling from the leaf. Neither species showed a discernable preference for plants of a particular size but *A. fossicollis* was usually found on the younger leaves. Neither species was observed on flowers or fruits of *R. hillii.*

Two additional native brambles, the Rose-leaf bramble *R. rosifolius* Sm. and the Green-leaved bramble or Bush lawyer, *R. moorei* F. Muell. were also regularly observed at Lansdowne. Only one adult of *A. nodosus*, feeding on the leaf edges of *R. moorei*, was observed. Both these *Rubus* spp. are associated with wet forests; *R. moorei* being known from Queensland and New South Wales and *R. rosifolius* from New South Wales and Victoria. Unlike the other *Rubus* spp. noted *R. rosifolius* dies back normally within 18 months of establishment on disturbed wet forest soils and has not been observed to form particularly woody canes.

Voucher specimens of *A. fossicollis* and *A. nodosus* have been lodged in the A.N.I.C., Canberra, and the Australian Museum, Sydney.

**Acknowledgments**

I would like to thank Dr E. B. Britton and Dr P. B. Carne both of the CSIRO Canberra for their criticisms and advice on the manuscript, Mr T. Weir, CSIRO, Dr C. N. Smithers and Mr O. Griffiths, the Australian Museum, and Mr S. Watkins, Sydney, kindly made available records of *Alcinous* spp. Dr E. R. Sinclair, DPI Queensland, made helpful suggestions on the final manuscript draft.

REFERENCES

Bruzzese, E. (1980) — The phytophagous insect fauna of *Rubus* spp. (Rosaceae) in Victoria, a study on the biological control of blackberry *(Rubus fruticosus* L. agg.). *J. Aust. ent. Soc. 19:* 1-6.

Carter, H. J. (1923) — Revision of the genera *Ethon, Cisseis* and their allies (Buprestidae). *Proc. Linn. Soc. N.S.W. 48:* 159-76.

*Galbraith, J. (1977) — Wild Flowers of south-east Australia.* Collins: Sydney and London.

Williams, J. B. (1980) — *A checklist of the rainforest flora of New South Wales. Pt. 2 Climbers.* Uni. New England: Armidale.

---

## The Derrinal Permian Glacial Valley

(Continued from page 36)

Another very interesting "erratic" found was a beautifully rounded and facetted clast about 25 cm. (10") diameter of Permian conglomerate + sandstone, and striated right across the join or boundary of the two. If we had found it embedded in situ in tillite, then we could have said it represented an "older Permian glacial deposit" becoming "an erratic" in a younger Permian tillite. This also suggests multiple glaciation.

**Postscript.** The author inspected this area on 26 Jan. 1983. He noted the lake level stood at 186.54 mm A.S.L. and was falling 2.5 cm per day. At this rate the level would fall below its record low recorded on 16 May 1978. He noted that very severe erosion had taken place at Frakes and Wilkinsons pavements and that the area is well worth a visit while so much is exposed.

**Editor.**

# "Common Australian Fungi"

BY TONY YOUNG

N.S.W. University Press, 1982. 20 x 12cm, 156 pp., 16 col. plates, 10 figs. & many marginal drawings
ISBN 0-86840-384-9. Price $9.95

Older mycologists in Australia were beset with difficulties when attempting to name the fungi collected around our countryside. They struggled rather hopelessly with M. C. Cooke's very inadequate text, *Handbook of Australian Fungi* published in 1892 — first general descriptive work on this subject, and the only one during the next 42 years. Then in 1934 came J. B. Cleland's *Toadstools and Mushrooms and other Larger Fungi of South Australia* (in two volumes); it proved a godsend to all local fungus hunters, immensely increasing interest in mycology and stimulating further research. His descriptions were ample and, for the first time, really useful in identifying specimens; but Cleland's flora was only regional, for one dry State, and its application to rain forests, the alps and the wet tropics was quite limited. Over the past two decades a further upsurge in mycological inquiry has coincided with some excellent monographs on such groups as the polypores, coral fungi and cup fungi, the re-publication of Cleland's volumes, and the appearance of several popular guides of varying scope and quality.

It is now a great pleasure to welcome *Common Australian Fungi* by A. M. Young. In this pocket-sized, strongly bound and modestly priced book, 220 species of the commoner higher fungi are adequately described. There are marginal drawings of fructifications (in section) and spore details against most diagnoses, and 71 species are portrayed in a series of 16 colour plates from watercolours by Kay Smith. The author has attempted to bring nomenclature up to date, and his chosen genera have been "arranged to conform with modern taxonomical theory", based chiefly on the writings of R. Singer and P. H. B. Talbot. Whilst the Friesian concept of genera has been largely superseded, as a result of modern microscopical research, fungal taxonomy still seems to vary somewhat with every successive specialist, and even world authorities often differ as to their acceptance of natural affinities.

A surprising amount of information is packed into the 156 pages of Young's new book which, before the principal section (on Species Descriptions), provides short chapters on The World of Fungi, Fungi and Man, The Study of Fungi and a well set-out, easily workable Key to the Common Genera of Australian Fungi.

In such a small volume, selectivity is inevitable; yet one is surprised by the omission of some very common, widespread genera, e.g. *Phellinus* and *Poria* among the Polyporaceae, *Phellodon, Podoscypha* and species like *Gymnopilus pampeanus, Panellus stipticus, Stereum fasciatum, Rhizopogon luteolus* (in pine plantations), *Tremella fuciformis* and *Heterotextus peziziformis*. As to nomenclature, one finds throughout the text (pp. 47-49, 63, 64, 86, 87, 100, 105, 118, 122-124, 142) a species name in bold type and underneath it a comment "NOW CALLED" so-and-so. Thus, for the five taxa treated beneath headings of *"Boletus"* spp. (pages 122-124) is the statement "NOW CALLED *Suillus* . . . *Gyroporus* . . . and *Phaeogyroporus* . . . ", as the case may be. It would have been preferable to head these descriptions with the present

accepted name, rather than with an old synonym.

Unless Commander Young had deliberately begged to differ, he has not taken advantage of all recent researches into nomenclature. For instance, according to Ponce de Leon's world revision of the Geasteraceae (1968), all three *Geastrum* species described in Young's volume (pp. 135-136) must be changed: *G. fenestriatum* to *G. quadrifidum* Pers., *G. limbatum* to *G. coronatum* Pers., and *G. triplex* to *G. indicum* (Klotz.) Rauschert. Again, *Collybia elegans* (p.68) and *C. velutipes* (p.69) have not been assigned to the genera *Marasmius* and *Flammulina* respectively, nor has *Tricholoma rutilans* (p.119) been referred to *Tricholomopsis* or *Tremellodon* (p.45) to *Pseudohydnum*. The majority of species described under *Hygrophorus* (pp.80-84) would now strictly be referrable to *Hygrocybe*. *Agaricus arvensis* var. *iodiformis* and *A. xanthoderma* (pp.57 & 59) are kept as distinct taxa, but in his "Preliminary Account of the Genus *Agaricus*" (1969) C. J. Shepherd equates the former with the latter.

Surely the statement (p.52) that "The genus *Hydnum* is now reserved for those species with rough or spiny spores" must be erroneous? In his well researched *Hydnaceous Fungi of the Eastern Old World* (1971), R. A. Maas Geesteranus describes the type species, *Hydnum repandum*, as furnished with *smooth* colourless spores. Furthermore, having examined the Australian type of Cooke's *H. crocidens*, Geesteranus considers that it differs in no significant feature from the European *H. repandum*.

It is a pity that a little more care had not been taken in listing geographical distributions (by States) at the end of ech diagnosis. For instance, *Stereum illudens* (p.50) is listed only for SA and NSW, whereas it occurs widely in all the States. In a few cases, the State whence the type collection came has been omitted, e.g. VIC from *Hydnum crocidens* (p.51), TAS from *Cortinarius archeri* (p.74) and VIC from *Trichoglossum walteri* (p.144).

Among other questionable matters is adoption of the name *Oudemansiella "radicans"* (p.102) for the widespread Rooting Shank, whose specific epithet — in all literature available to the reviewer — has always been *radicata*. Smell of the phalloid *Clathrus gracilis* (p.127) is said to be "foetid, as of faeces or rotten meat", but I have found it to be slightly foetid at expansion, then with a pronounced iodiform-like smell. This curious Basket Fungus occurs in TAS and QLD, as well as in the other four States cited.

In the Glossary (pp.145-148) several definitions appear to be misleading, thus:

*habitat* means environment at the place of natural occurrence, not the ambiguous "growing area of a fruiting body".

*hyphae* are thread-like tubes rather than 'cells".

*mycelium* is hardly "the fungal plant", but that part of it concerned with food absorption.

*sessile* means without a stalk-attachment rather than "attached directly to the substrate".

*tomentose* denotes woolly rather than "velvety" (for which the term is *velutinate).*

*umbo* means a central boss rather than simply "a swelling".

The colour plates are generally recognizable, but some are oddly proportioned, e.g. in the phalloids *Aseroë* (with excessively narrow spidery arms to the receptacle) and *Dictyophora* in which the pileus is too narrowly and sharply conical. It is to be regretted that there is no index to these illustrations, which have been tipped in willy-nilly, nor are they referred to in the descriptive text. Typographical mistakes are quite

minimal, due to meticulous proof-reading, but the following have been noted:

Transposed species names in the captions for colour pictures No. 3 *Paxillus "involutus"* and No. 5 *P. "infundibuliformis"*, also for No. 3 *Cordyceps "gunnii"* and No. 5 *C. "militaris"*.

Page 9, 2nd last line — "definately" should be definitely.

P.55 — *Cantharellus "cinnabarina"* should read *cinnabarinus* (masculine).

P.114 — *Russula "Mariae" should read mariae* (l.c.)

P.145 — "capillitum" should be capillitium.

A select Bibliography of 43 references precedes the Species Index.

Hopefully the reviewer will not appear to be hypercritical in assessing this fine production, which he will use often and profitably. It is good value for money and is by far the most comprehensive guide to Australian higher fungi since Cleland's. For a splendid effort congratulations are due both to Tony Young and his publisher (N.S.W. University Press). *Common Australian Fungi* is ardently recommended for all botanical libraries, students of mycology, field naturalists' organizations and the interested public at large. May we see further editions, and perhaps a second volume!

**— J. H. WILLIS**

---

## Field Naturalists Club of Victoria

### Reports of recent activities

**General Meeting**
**Monday 13 December**

**Honorary Membership** was awarded, in absentia, to Mrs Doris McKellar who completed 40 years membership this month.

**Speaker** for the evening was Mr Paul Genery with his film on "Wonders of Pond Life". Before starting the film Mr Genery said that much of it was about rotifers; he had a blackboard diagram showing the cilia on the body of rotifers and explained the cilia movement which, under the poor microscopes of 300 years ago, looked like the spinning of cogged wheels and hence the animals were named rotifers. Although today's high powered microscopes have solved the method of cilia movement, the film endorsed the impression of rotating wheels. Rotifers are all microscopic in size, up to about 0.2mm, all are transparent but vary in shape. One resembled a vase or tall wine glass with a slender stem — the "foot". Another had a telescopic foot, while in another species the whole body kept revolving and then reversing without pause.

As well as the several rotifers, Mr Genery showed protozoans, volvox, diatoms, the larvae of various flies, etc. It was a remarkable film and gave the layman a glimpse of the vast number of creatures the microscope can reveal.

**Conservation.** The President read the telegram sent under the Club's name to the acting Prime Minister in protest against the cabinet's decision not to halt the Franklin dam, and the draft of a letter to be sent to various ministers was read and discussed. Other conservation matters included a submission for the extension and junction of the national parks in the alps.

**Exhibits.** Under a microscope was a hydroid (from Black Rock) that is possibly a new record for Victoria. Another microscope showed a cluster of orange eggs of a Parapsis beetle, and the beetle itself about 1cm long. In bottles

## GROUP EXCURSIONS

All FNCV members are invited to attend Group excursions.

(Continued from inside front cover)

**Mammal Survey.**
Saturday, 19th — Sunday, 20 February. Torbreck River.
Saturday, 12 — Monday, 14 March. Mt Elizabeth or Providence Ponds.
Friday, 1 — Monday, 4 April. Easter. Grampians.

**Botany Group.**
Saturday, 26 February. Cape Schanck.
Saturday, 19 March. Tree expedition led by Pat Carolan.
Saturday, 23 April. Autumn flower expedition.

---

were preserved specimens of two species of bats from Traralgon, and an adult and young blind snakes from Swan Hill; the adult blind snake was about 25cm long (10") with diameter 0.8mm.

The meeting ended with the usual "serve-yourself" tea or coffee.

### General Meeting
### Monday 10 January

This was a members night and there were three speakers.

**Plants in the drought.** Mrs Hilary Weatherhead reported a brief survey of native plants in the triangle between South Belgrave, Macclesfield and Upper Beaconsfield. Hilary found 22 plants in flower while in an ordinary year at the same season she would expect about 30. But, anticipating worse, she was pleasantly surprised by her findings, and in any slight hollows the plants there were doing well. She estimated there was enough for insects, birds, etc, but thought there seemed fewer birds than usual.

**Marine life at Western Port.** Dr Brian Smith spoke of the abundant life of the rock platform at Honeysuckle Point which is in contrast to the exposed shore at Cape Schanck. Both these areas will be visited in an excursion next month.

Air photos gave us a good idea of the platform at Honeysuckle Pt. It is composed of two sorts of basalt — soft old material towards the middle of the platform and hard young rocks that form a rampart on the outside edge. A wide range of creatures live in such an environment and Brian showed slides of some of them. And he showed slides of the life history of the Brown Cowrie (about 15mm long) with its egg capsules. Each capsule contains several eggs but only one embryo develops. It emerges from the capsule fully formed complete with shell, then about 1.5mm. Further whorls are added to the shell as the animal grows.

**Animals at Roger River.** Miss Wendy Clark spoke about the Christmas camp of the Mammal Survey Group at the headwater area of the Roger River which, it is hoped, will be added to the Snowy River National Park. It is the type area for the Long-footed Potoroo. No Potoroos were seen, but there were many tree animals, several reptiles, Sooty Owls were often heard, also the Powerful Owl, and their bird list was lengthy. They trapped 10 different species of bats, taking 30 to 50 each night. Asked how bats are trapped, Wendy said there are three methods but all depend on knowledge of the regular flight course. When on a familiar course, it is surmised that bats are less alert, that the echo-sounding device is not used for ordinary navigation but only for catching prey, and they easily blunder into nets or wires placed across their route.

(To be continued in next issue)

# *Field Naturalists Club of Victoria*

Established 1880

**OBJECTS:** To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

*Patron:*
His Excellency Rear Admiral Sir Brian S. Murray, KCMG, AO.

**Key Office-Bearers 1982-1983**

*President:*
Miss WENDY CLARK, 27 Rangeview Grove, North Balwyn, 3104 (859 8091 A.H.)
*Vice-President:* Dr. B. Smith, C/- The National Museum, Russell Street, Melbourne
*Secretary:* Mrs. Sheila Houghton, 30 Golf Links Crescent, Dingley, 3172 (551 2708)
*Correspondence to:* FNCV, National Herbarium, The Domain, South Yarra, 3141
*Treasurer:* Mr. D. DUNN, 3 Allfrey Street, East Brighton, 3187 (578 5753)
*Subscription-Secretary:* Miss H. MALCOLM C/- National Herbarium, The Domain, South Yarra, 3141
*Editor:* Mr. R. WALLIS, Victoria College — Rusden Campus, 662 Blackburn Road, North Clayton, 3168 (544 8544)
*Librarian:*
*Excursion Secretary:* Miss M. ALLENDER, 19 Hawthorn Avenue, Caulfield, 3161 (527 2749)
*Book Sales Officer:* Mr. D. E. McINNES, 129 Waverley Road, East Malvern, 3145 (211 2427)

**Group Secretaries**

*Botany:* Mr. MICHAEL McBAIN, 19 Foster Street, St. Kilda, 3182 (534 2293)
*Day Group:* C/- National Herbarium, The Domain, South Yarra, 3141
*Geology:* Mr. T. SAULT, C/- National Herbarium, The Domain, South Yarra, 3141
*Mammal Survey:* Mr. A. FAITHFUL, 67 Athelstan Road, Camberwell, 3124 (29 5108 A.H.)
*Microscopical:* Mr. M. H. MEYER, 36 Milroy Street, East Brighton (596 3268)
*FNCV Kinglake Nature Reserve:* McMahons Road, Kinglake
*Booking and keys:* Mr. I. F. MORRISON, 788 Elgar Road, Doncaster (848 1194)

**MEMBERSHIP**

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

**Subscription rates for 1982**

| | |
|---|---|
| Metropolitan | $15.00 |
| Joint Metropolitan | $18.00 |
| Country Members and Retired Persons | $12.00 |
| Joint Country and Joint Retired | $15.00 |
| Junior | $3.00 |
| Subscription to Victorian Naturalist | $13.00 |
| Overseas Subscription to Victorian Naturalist | $15.00 |
| Individual Journals | $2.20 |

All subscriptions should be made payable to the Field Naturalist Club of Victoria and posted to the Subscription Secretary

JENKIN BUXTON PRINTERS PTY. LTD., WEST MELBOURNE

# The Victorian Naturalist

Vol. 100, No. 2
March/April
1983

Published by the FIELD NATURALISTS CLUB OF VICTORIA
in which is incorporated the Microscopical Society of Victoria

Registered by Australia Post. Publication No. V.B.P. 1268

$2.20

# GENERAL MEETINGS

**Monday, 11th April, 8.00 p.m.**

Evolutionary history of the Phylum Echinodermata. Speaker: Dr Peter Jell. At this meeting Honorary membership will be awarded to Mrs Florence Vasey.

**Monday, 9th May, 8.00 p.m.**

Annual General Meeting. Election of office bearers and Council Members. Speaker: Miss W Clark, FNVC President.

**Monday, 6th June, 8.00 p.m.**

Current trends in forest entomology. Speaker: Dr E. Newman.

Please note change of date

**New Members — March/April General Meetings.**

*Metropolitan*

Ron Crawford, 23 Hawthorn Rd, East Brighton (Microscopy)

Jennifer Davies, 1 College Place, Albert Park (Marine and freshwater biology)

Eileen Durran, 17 Stanhope Grove, Camberwell

V. Hepburn, 9/13 Kneep Rd, Balwyn

R. Hogan, 7 Layfield St, South Melbourne

Dr C. & Mrs L. Jones, 5/10 Walmer St, Kew (Geology, ornithology)

Jeanne Kidd, 25 Raymond St, Ashwood (Botany)

Stefanie Resnick, 11 Langeset St, East Bentleigh

Joyce Shipp, 18 Valentine Grove, Armadale

E. Vernon, 8/13 Kneep Rd, Balwyn

*Country*

Anne Geary, P.O. Box 126, Heywood (Conservation)

Fay Jackman, Mid St, Bendigo

*Town*

Mark & June Roche, Box 1117, Shepparton

Jean Wallis, 7 Dudley St, Matcham

Trevor & Rosemary Wellby, 18 Elizabeth St, Elsternwick

# FNCV EXCURSIONS

**Sunday, 1st May.** Understanding soils. Leader: Mr G. Love. The party will visit several areas near Melbourne and compare the soils using soil testing equipment. The coach will leave Batman Avenue at 9.30 a.m. Fare $7.00. Bring a picnic lunch.

**Sunday, 5th June.** Dandenong Ranges. Leader: Mrs. Hilary Weatherhead. The coach will leave Batman Avenue at 9.30 a.m. Fare $7.00. Bring one meal.

**Friday evening, 2nd — Sunday, 4th September.** Weekend campout. This is being organized by John Milligan and Dr J. H. Willis, probably at Cathedral Range, but destination will be changed if the area is affected by fires. Travel will be by private cars leaving Friday evening. Saturday there will be a walk to one of the lesser known parts of the Range, Sunday to an area nearer the camp, returning to Melbourne later in the day. Details later. Bookings should be made with John Milligan (A.H. 557 3509).

It is hoped this will be the first of a series of campouts.

**September, 16th — 30th.** Lord Howe and Norfolk Islands. Will members interested in this excursion please notify the Excursion Secretary as soon as possible. The proposal is to fly to Lord Howe Island from Sydney on Friday, 16th September, remaining there until Friday, 23rd, then flying direct to Norfolk Island for the rest of the trip, returning to Sydney on Friday, 30th September. Accommodation on Lord Howe Island is full board and on Norfolk Island in self contained apartments. The cost Sydney to Sydney is about $1,125 on current prices. Bookings should be accompanied by a $100 deposit and sent to the Excursion Secretary.

# GROUP MEETINGS

FNCV members are invited to attend any Group Meeting.

**Day Group — Third Thursday.**

Thursday, 21st April. Puffing Billy. Leader: I. Gillespie (878 1879)

Thursday, 19th May. Numawading Horticultural Centre. Leaders: I. & M. Wilson (836 3521)

Thursday, 16th June. Arts Centre and Melbourne Concert Hall. Leader: R. Graham (469 2509)

**At the National Herbarium, Birdwood Avenue, South Yarra, at 8.00 p.m.**

**First Tuesday — Mammal Survey Group.**

Tuesday, 3rd May. To be announced.

Tuesday, 7th June. To be announced.

**First Wednesday — Geology Group.**

Wednesday, 4th May. The fertility of soils in respect of geological processes.

Wednesday, 1st June. What rock is that? — a group exercise.

**Third Wednesday — Microscopy Group.**

Wednesday, 20th April. Insects. Speaker: Mr Urwin Bates.

Wednesday, 18th May. Human cells: a continuation of a previous talk by Dr Peters.

Wednesday, 15th June. Microscopical marine life. Speaker: Mr Dan McInnes.

**Second Thursday — Botany Group.**

Thursday, 14th April. Tundra. Speaker: Mary Doery.

Thursday, 12th May. 1982 Western Australia expedition.

Thursday, 9th June. Members night.

# GROUP EXCURSIONS

All FNCV members are invited to attend Group Excursions.

**Mammal Survey.**

Saturday, 14th — Sunday, 15th May. Camp. To be announced.

Saturday, 11th — Sunday, 12th June. Camp. To be announced.

**Botany Group.**

Saturday, 23rd April. Autumn flowers expedition.

Saturday, 28th May. Fungi expedition — Beenak Forest. Leader: Bruce Fuhrer.

Saturday, 25th June. Visit to Natural Resources Conservation League.


# The Victorian Naturalist

Volume 100, Number 2 March/April, 1983

ISSN 0042-5184





*Cover illustration:* Dune blowout. In the foreground one beach daisy plant is growing amidst spiny rolling grass. The beach daisy is a potential dune stabilizer. (See article by Heyligers)

# An Appraisal of the Beach Daisy *(Arctotheca populifolia)* With a View to Its Possible Use For Dune Stabilization

By Petrus C. Heyligers*

**Summary**

The beach daisy is a semi-succulent plant with a low, spreading growth habit, confined to unstable littoral habitats such as storm beaches and mobile dunes. Native to southern Africa, it appeared in Australia during the 1920s and has since extended its occurrence along shores with climates similar to those of its African range. It is a non-aggressive, rapidly growing species easily propagated from seed. The plants withstand sand blast, thrive in accumulating sand and build only low mounds. These characteristics, combined with its drought-tolerance, would seem to make the beach daisy a candidate for sea shore and dune reclamation in areas marginal or unsuitable for species like marram grass.

**Introduction**

The beach daisy *(Arctotheca populifolia* (Berg.) T. Norl., syn. *A. nivea* (L.f.) Lewin, *Cryptostemma niveum* (L.f.) Nichols, family Asteraceae) inhabits unstable sandy coastal habitats. In 1979 I discovered a substantial population in a blowout near Coffin Bay on the Eyre Peninsula (Fig. 1). Impressed by its capacity to catch a considerable amount of sand, I surmised that this species could be of use in dune stabilization projects and decided to find out more about it. The present paper reports on this research. It is divided in three parts: a description of the plant; an overview of its distribution and migration history; and some remarks about its possible suitability for dune habitization.

* CSIRO, Division of Water and Land Resources, P.O. Box 1666, Canberra City, A.C.T. 2601.

**The Plant**

Beach daisies are annual or perennial, semi-succulent, much-branched, more or less prostrate plants covered with a fine, white tomentum (Fig. 2). The leaves are usually ovate, sometimes sinuate, about 8 cm across and are grouped in rosette-like clusters. The relatively small inflorescences are carried on axillary stalks. The flowers are yellow; about a dozen short ray-florets surround the crowded disk-florets. Commensurate with their pioneering qualities, beach daisies flower most of the year. After flowering the stalks bend over and if sand is accumulating at a fast rate, the inflorescences are soon buried. Otherwise, when seeds reach maturity, the stalks straighten up, exposing the infrutescences above the general leaf-surface. The brown achenes are about 5 mm long and 2 or 3 mm across. They are covered with a greyish wool, but length and density of the hairs are variable and inadequate to keep a seed air-borne. The seeds which are dropped around the periphery of the plant can easily be

Fig. 1. Blowout on Coffin Bay Peninsula, South Australia. In the foreground one beach daisy plant is growing amidst spiny rolling grass *(Spinifex hirsutus);* in the middleground several plants can be seen accumulating low mounds on the blowout floor

Fig. 2. Close-up of a beach daisy plant growing on the storm beach near Brou Lake, N.S.W.

blown by the wind over bare sandy surfaces, whilst those that lodge within the shelter of the plant may have to wait for a storm high tide for their dispersal. Floating seeds remain buoyant only for a few days. Their capacity for survival when submerged, as well as their longevity in general, is unknown.

Beach daisies can be readily propagated from seed. As a matter of historical curiosity, Bergius used plants raised in the botanical garden of Leiden, The Netherlands, for his description of this species, published in 1767 (Norlindh 1967). The seeds have no innate dormancy and the germination rate is high, at least for fresh seeds. Initially erect, the seedlings become decumbent at the four-leaf stage. During further growth the terminal clusters remain upright whilst the stems become prostrate. The earliest leaves are opposite and lanceolate; later ones alternate and broader, attaining the ovate shape from about the eighth leaf onward.

Norlindh (1967) who grew beach daisies in Swedish botanical gardens from seeds collected in Africa, observed that in some young plants the leaf shape is quite uniform, viz. broadly elliptic or ovate, while in others one or more lobes may develop at the base of the blade, vestiges of which persist in older plants in the form of sinuate leaves. He attributes the development of lobate forms to "ample nutrition and suitable humidity and heat".

**Distribution and Migration**

In considering the geographic distribution of the beach daisy (Fig. 3), it has to be kept in mind that this species is restricted to habitats with loose, mobile sand. Hence unsuitable edaphic conditions rather than climatic factors may account for considerable gaps in the overall range.

In Africa the beach daisy occurs along the southern coast, from Lamberts Bay to Maputo. In the Cape of Good Hope-Cape Agulhas region it is one of the low, sprawling succulents and semi-succulents amongst the pioneer grasses on and along the seaward slopes of the foredunes (Muir 1937; Walsh 1968; Boucher 1978; Taylor 1978). The climate in this region is "mediterranean", i.e. characterized by good winter rains and intense summer droughts. Towards the north as well as further east along the southern coast, winter precipitation decreases and the climate becomes semi-arid. In the Lamberts Bay area however, due to the influence of the cold Benguela Current, fogs are common and make a substantial contribution to the total precipitation (Nagel 1962, quoted by Schulze & McGee 1978). In the low rainfall section along the southern coast, viz. in the Riversdale area, the beach daisy "is of rare occurrence" (Muir 1929).

Between Mosselbaai and Port St Johns beach daisies are common along the upper beach and in mobile dunes, and grow in large, pure patches (Phillips 1931; Dyer 1937; Muir 1937; Comins 1962). The climate in this part of its range is characterized by mild temperatures, excess summer rainfall and generally adequate moisture conditions throughout the rest of the year. Further northwards the beach daisy becomes an unimportant member of the pioneer vegetation, which is usually

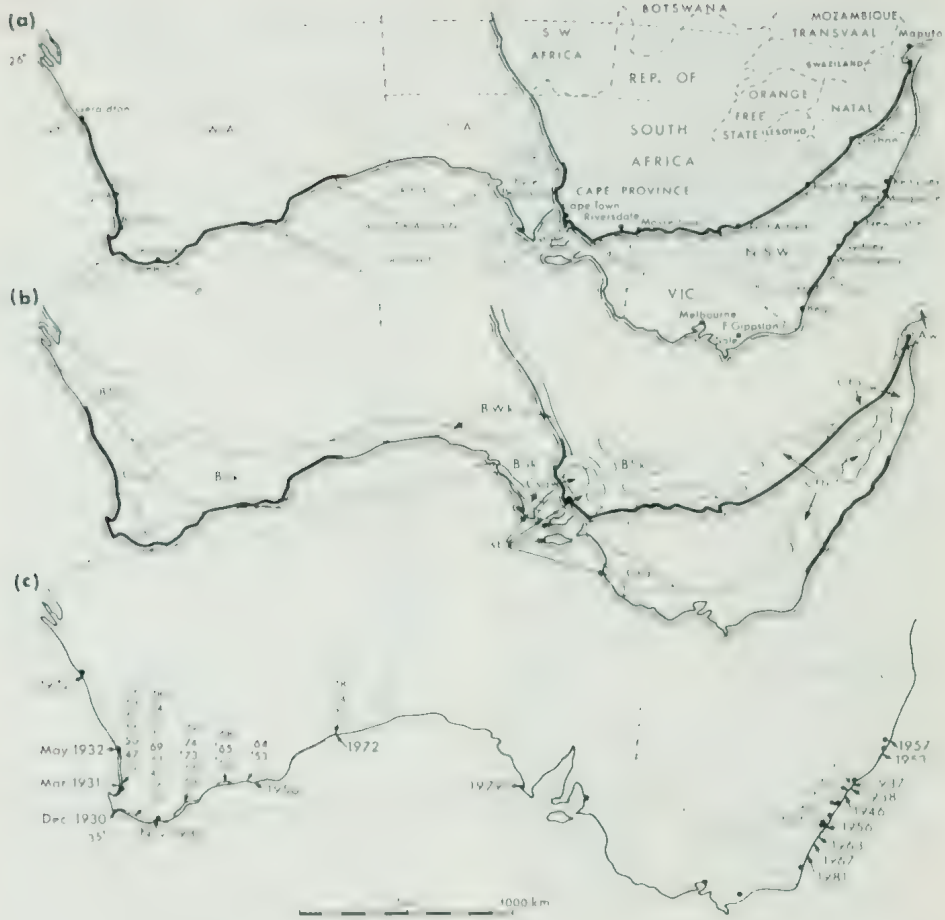



Fig. 3. The geographic distribution and migration history of the beach daisy.

a Locality map with names used in the text. The map of southern Africa has been latitudinally transposed onto southeastern Australia to assist in comparing the ranges. In this map and the next the heavy-outlined part of the coast indicates the general distribution of the beach daisy.

b Climatic regions of southern coastal Africa and Australia according to Koeppen's classification (after Gentilli (1972) and Schulze & McGee (1978). the following classes are represented:
Aw: hot, humid climate with a long dry season in the "winter" half-year;
BW: arid, and BS: semi-arid climates with mean annual temperatures below (k) or above 18°C (h), either with evenly distributed rainfall (without symbol) or with rainfall concentrated in the winter months (s);
Cs: "mediterranean" climates with winter rains and hot, dry summers (a), or long, mild summers (b);
Cf: humid, mild-winter climates with appreciable rainfall throughout the year, either with hot summers (a), or with mild summers (b).

c The spread of the beach daisy in southern Australia. The significant early dates for various sections of the coast are given "off-shore"; subsequent dates, probably reflecting frequency of occurrence, "inland". The dates were obtained from herbarium collections (see Acknowledgements) or location-specific published records (Sauer 1965; Burbidge 1980; Beadle 1981).

dominated by the fan-flower *Scaevola thunbergii* Echl. & Zeyh. (Moll 1972; Weisser 1978; Ward 1980). Nevertheless it occurs all along the Natal coast and extends into Mozambique, where according to herbarium records its northernmost locality is Inhaca Island, about 35 km east of Maputo (Norlindh 1967). The coast of Natal extends from the warm temperate zone into the subtropics and generally receives ample rainfall throughout the year, peaking in the summer. There is seldom, if ever, a soil moisture deficit except in the very north where, due to increasing temperatures, "winter" droughts are likely to occur (Moll 1978; Schulze & McGee 1978).

In Australia the earliest herbarium collections of the beach daisy were made at William Bay in November 1930 and near Cape Leeuwin in December 1930 (Fig. 3c). Later during that season, in March 1931, it was collected near Bunbury and the next year, in May 1932, at Swanbourne, a seaside suburb of Perth. By the late 1930s *A. populifolia* was firmly established along the coast from Perth to Wilson Inlet near Denmark.

Judging from the admittedly incomplete evidence provided by herbarium collections, and the fact that Sauer (1965) does not mention this species for his "Central West Section", the spread in a northerly direction stagnated until 1972, when the species was found near Geraldton. However, its range expanded along the southern coast, where it was collected at the Duke of Orleans Bay in 1950 and photographed at Twilight Cove in 1972 (Beadle pers. comm. re Beadle (1981), Fig. 23.5).

The coastal climates in southwestern part of W.A. resemble those prevailing in the Cape of Good Hope region, but, as shown by Milewski (1981), there are some ecologically important differences in rainfall patterns. The west coast of southern Africa, under the influence of the cold Benguela Current, receives only comparatively light falls of winter frontal rains, whereas in Western Australia warm offshore waters tend to intensify such rains. Also, during late summer and autumn, tropical storms occasionally penetrate far south and reach the shores of the Great Australian Bight. Geraldton, generally drier and warmer than the Bunbury coast, still lies within the region with "mediterranean" climate, but conditions at Twilight Cove are semi-arid and probably comparable to those at the Lamberts Bay and Riversdale coasts in southern Africa. Whereas at Lamberts Bay fog is an important component of the precipitation, at Twilight Cove dew and the occasional late summer storm may be important to the survival of the beach daisy.

In the 1930s beach daisies also appeared on the east coast. Newcastle was probably the port of entry, as the earliest collections held by the National Herbarium of New South Wales were made at Nelson Bay in February 1937 and at Swansea in april 1938. Mort (1949) reports the beach daisy as a "minor creeping plant" amongst the strand and foredune flora of the N.S.W. North and Central Coast, implying that it did not occur south of Wollongong. However, in 1956 it was collected at Jervis Bay and has since been collected further southward. A few well-developed plants growing on the storm beach along the foot of cliffed hills south of Brou Lake in December 1981 are so far the southernmost record. The frequency of the herbarium collections would suggest that at present beach daisies are fairly common between Nelson Bay and Jervis Bay, but rare further north and south.

The east coast range is humid throughout the year, with summer rains more prevalent in the north, giving way to winter rains in the south. However, rainfall is variable and droughts occur from time to time (Gentilli 1972). Southerly busters, wind squalls followed by thunder storms and heavy rain, are a

feature of the warm season along this part of the coast. In comparison with southeastern Africa the climate of the Central Coast of N.S.W. is somewhat more humid than, but otherwise similar to that along the coast from Mossel Bay to Port St Johns, whilst the coastal climate of northern N.S.W. and southeastern Queensland and that of Natal have much in common. However, the drier area near Maputo does not have a counterpart at a similar latitude in Australia.

In 1979 a single beach daisy locality was discovered in the southwest of the Eyre Peninsula. The climate in this area and along the west coast of the peninsula to about Streaky Bay is — again — "mediterranean".

From these admittedly rather broad comparisons it would appear that there is no obvious climatic barrier to a further northward spread of beach daisies along both the N.S.W. and Eyre Peninsula coasts. However, a southward migration towards and into Victoria would take the beach daisy into a region with a cool, moist climate, which has no homoclime in South Africa (Gentilli 1972; Papadakis 1975). Temperatures are appreciably lower and frosts are common during the winter, averaging 24 per annum at Sale and increasing to 30 at Bega (Gentilli 1972; Kalma & McAlpine 1978). Frost occurrences along the beach will be fewer, but as the beach daisy range in Africa is practically frost-free (Schulze & McGee 1978), frost could well be an important limiting factor in its distribution in southeastern Australia.

**Suitability as a Sand Stabilizer**

In South Africa the beach daisy has been used for dune reclamation. Discussing the driftsands in the Cape Agulhas region Walsh (1968) states that "it is a good sand binder, often used for sand work in former times, but not used at all in the south-western Cape of late, so that no further details of growth are available at the moment" and lists it amongst the littoral species "which should possibly be used again". Mort (1949), who surveyed the beaches and unstable dunes along the N.S.W. coast for suitable sand-binding species, mentions the beach daisy amongst the "mat-forming and creeping plants", but Sless (1958) does not list it with the species tried by the Soil Conservation Service. No other relevant references were found and I assume that at least in Australia the beach daisy has never been cultivated or investigated as to its usefulness for sand stabilization works. Therefore, in the following paragraphs some beach daisy characteristics will be discussed which relate to its potential as a sand-binder.

Beach daisies grow equally well in calcareous and siliceous sand. The geographic distribution indicates that conditions for establishment are optimal in warm-temperature climates with ample winter rainfall. Hot summer conditions may be detrimental to seedling establishment, as Phillips (1931) mentions that seedlings of the fan-flower *Scaevola thunbergii*, found in similar habitats, are damaged by high temperatures of the surface sand. However, once established, the plants are able to withstand long periods of hot and dry weather. Effects of drought are likely to be tempered by the interception of dew, fog or light rain, for which purpose the leaves with their woolly indumentum may be well-adapted. Hence its greatest usefulness could be expected in drier regions where conditions are marginal for the usual suite of cool-temperate pioneer species, such a marram grass *(Ammophila arenaria* (L.) Link) and sea wheat-grass *(Agropyron junceum* (L.) Beauv.).

The spreading growth habit is another factor important for the potential usefulness of this species. High, steep hillocks such as those built by the fan-

flower or marram grass, may induce wind-funnelling and hence foster erosion of the vales, whilst a low profile would be advantageous for the deposition of sand over a long front (Phillips 1931; Gohl 1944).

Whilst on the storm beach the beach daisy is a primary colonizer, this is not necessarily the case in the mobile dunes. In the shifting dunes near Port Alfred the initial colonization of slip-face slopes is by pyp grass *(Ehrharta villosa* Schult.), a stiff, erect plant which is able to grow through great depths of sand, but produces only an open cover. Eventually it stablizes the slope sufficiently to allow further colonization, especially on the lower slope, by about half a dozen other species, including the beach daisy (Dyer 1937). Presumably the pyp grass slows down sand deposition to such an extent that irreversible burial of young beach daisy plants is prevented. However, if sand accumulation on the leeward slopes is only moderate, beach daisies and other pioneers will invade without the aid of pyp grass and "slowly but surely capture ground" (Phillips 1931).

Beach daisies are very tough plants as shown by the following quote from Walsh (1968): "At a section of the Walkers Bay sand drift, where sandblast from abnormally large sand grains or shellgrit killed off all other vegetation used for reclamation work, (the beach daisy) was observed to be the only species which was able to resist the blast".

Last but not least it should be pointed out that in Australia the beach daisy unlike some of its compatriots, e.g. false onionweed *(Trachyandra divaricata* (Jacq.) Kunth.) in Western Australia (Smith 1973) and coastal boneseed *(Chrysanthemoides monilifera* (L.) T. Norl. ssp. *rotundata* (DC.) T. Norl.) in New South Wales (Gray 1976), has not shown any tendency to spread beyond the habitats to which it is confined in Africa nor to compete with any native shrubs found on the young dunes (Smith 1968). It is this non-aggressiveness in conjunction with its ability to thrive in accumulating sand, that in my view makes this species a candidate for sea shore and dune reclamation works.

**Acknowledgements**

I would like to express my sincere thanks to the curators and members of staff of the following herbaria for providing information on beach daisy collections: Botany Departments of the University of New England and of the University of Western Australia, Canberra Botanic Gardens, Herbarium Australiense, Herbarium of the Northern Territory, National Herbarium of New South Wales, National Herbarium of Victoria, Queensland Herbarium, Rijksherbarium, State Herbarium of South Australia, and Western Australian Herbarium.

I am grateful to Professor N. C. W. Beadle for checking the date of one of the photographs in "The Vegetation of Australia", to Dr E. H. Bigalke, Director of the East London Musuem, for locating a reference and to colleagues and referees who commented on the manuscript.

I would like to thank the staff of the CSIRO Black Mountain Library and the Editorial Section of the Division of Water and Land Resources for their efficient assistance.

REFERENCES

Beadle, N. C. W., (1981). *The Vegetation of Australia.* Cambridge Univ. Press: Cambridge.

Boucher, C., (1978). Cape Hangklip area. II. The vegetation. *Bothalia 12:* 455-497.

Burbidge, A. H., (1980). Preliminary list of plants occurring in the Cocklebiddy-Eyre region, Western Australia. *Eyre Bird Observatory Report* 1977-1979, pp. 40-47. Royal Australasian Ornithologists Union, W. Aust. Group: Perth.

Comins, D. M., (1962). The vegetation of the Districts of East London and King William's Town, Cape Province. *Mem. Bot. Surv. S. Afr. 33:* 1-32.

Dyer, R. A., (1937). The vegetation of the Districts of Albany and Bathurst. *Mem. Bot. Surv. S. Afr. 17:* 1-138.

Gentilli, J., (1972). *Australian Climate Patterns.* Nelson: Melbourne.

Gohl, C. R., (1944). Drift sand reclamation and coast stabilisation in the south-western districts of the Cape Province. *J. S. Afr. For. Assoc. 12:* 4-18.

Gray, M., (1976). Miscellaneous notes on Australian plants. 2. *Chrysanthemoides* (Compositae). *Contrib. Herb. Aust. 16:* 1-5.

Kalma, J. D. & McAlpine, J. R., (1978). Climate. In: *Land Use on the South Coast of New South Wales* (M.P. Austin and K. D. Cocks, general editors), pp. 1-15. CSIRO: Melbourne.

Milewski, A. V., (1981). A comparison of vegetation height in relation to the effectiveness of rainfall in the mediterranean and adjacent arid parts of Australia and South Africa. *J. Biogeogr. 8:* 107-116.

Moll, E. J., (1972). A preliminary account of the dune communities at Pennington Park, Mtunzini, Natal. *Bothalia 10:* 615-626.

Moll, E. J., (1978). The Indian Ocean coastal belt. II. Vegetation and ecology. In: *Monographiae Biologicae* Vol. 31: *Biogeography and Ecology of Southern Africa* (M. J. A. Werger, ed.), pp. 575-598. Junk: The Hague.

Mort, G. W., (1949). Vegetation survey of the marine sand drifts of New South Wales. Some remarks on useful stabilising species. Part I. Introduction. *J. Soil Conserv. Serv. N.S.W. 5:* 84-91.

Muir, J., (1929). The vegetation of the Riversdale area, Cape Province. *Mem. Bot. Surv. S. Afr. 13:* 1-86.

Muir, J., (1937). The seed drift of South Africa and some influences of ocean currents on the strand vegetation. *Mem. Bot. Surv. S. Afr. 16:* 1-128.

Norlindh, T., (1967). *Arctotheca populifolia* (Berg.) T. Norl. *comb. nova*, a South African sand dune plant. *Aquilo, Ser. Bot. 6:* 84-93.

Papadakis, J., (1975). *Climates of the World and their Potentialities.* Libro de Edicion Argentina: Buenos Aires.

Phillips, J. F. V., (1931). Forest succession and ecology in the Knyssa region. *Mem. Bot. Surv. S. Afr. 14:* 1-327.

Sauer, J., (1965). Geographic reconnaissance of Western Australian sea shore vegetation. *Aust. J. Bot. 13:* 36-69.

Schulze, R. E. & McGee, O. S., (1978). Climatic indices and classifications in relation to biogeography of Southern Africa. In: *Monographiae Biologicae* Vol. 31: *Biogeography and Ecology of Southern Africa* (M. J. A. Werger, ed.), pp. 19-52. Junk: The Hague.

Sless, J. B., (1958). Coastal sand drift. Part II. Control Measures. *J. Soil Conserv. Serv. N.S.W. 14:* 184-190.

Smith, G. G., (1968). Plants of the seashore, a western landscape. *Wildl. Aust. 5:* 66-68.

Smith, G. G., (1973). *A Guide to the Coastal Flora of South-western Australia.* Handbook No. 10. W. Aust. Naturalists' Club: Perth.

Taylor, H. C., (1978). Capensis. In: *Monographiae Biologicae* Vol. 31: *Biogeography and Ecology of Southern Africa* (M. J. A. Werger, ed.), pp. 171-228. Junk: The Hague.

Walsh, B. N., (1968). Some notes on the incidence and control of driftsands along the Caledon, Bredasdorp and Riversdale coastline of South Africa. *Dept. For. Bull. 44:* 1-79.

Ward, C. J., (1980). The plant ecology of the Isipingo beach area, Natal, South Africa. *Mem. Bot. Surv. S. Afr. 45:* 1-147.

Weisser, P. J., (1978). Conservation priorities in the dune area between Richards Bay and Mfolozi Mouth based on a vegetation survey. *Natal Town and Regional Planning Report 38:* 1-64.

## Australian Natural History Medallion Fund

| | |
|---|---|
| Amount on hand May 1982 | $1868.50 |
| Gould League of N.S.W. 3rd Donation | 15.00 |
| Society for Growing Australian Plants 2nd Donation (Tasmanian Division) | 25.00 |
| Miss Helen Aston 3rd Donation | 25.00 |
| National Resources Conservation League of Victoria. | 25.00 |
| Total Amount January 1983 | $1958.50 |

# Bush-peas of Victoria — Genus *Pultenaea* — 16

BY M. G. CORRICK*

***Pultenaea patellifolia* H. B. Williamson in *Proc. Roy. Soc. Vict.* new ser. 4: 60 (1928).**

*P. patellifolia* is endemic in the Grampians Black Range and is almost confined to the slopes of Mt. Byron, but there it is quite plentiful. It is a spreading, rather open, almost glabrous shrub 1-1.5 m high. The stems are terete and slightly pubescent when young.

The alternative, almost orbicular leaves are 3.0-3.5 mm in diameter with upturned margins and a recurved, shortly mucronate tip, giving them a dish-shaped appearance, as the specific name implies. The upper leaf surface is glabrous and the lower surface is minutely scabrid with prominent veins and scattered pale hairs which are thicker at the base of the leaf.

The dark brown, lanceolate, resinous stipules are about 1.0 mm long and may be quite inconspicuous.

The orange and deep purple flowers are on pedicels up to 7 mm long; they are axillary, although clustered at the tips of the branches and often appearing sub-umbellate. The orange standard is 10-11 mm high and 11-12 mm wide with distinct purple lines in the throat. The wings are orange, very slightly tinged with purple and the keel petals are purple.

The calyx is about 5 mm long with short, obtuse lobes and scattered pale hairs.

The almost orbicular, overlapping bracteoles are about 1.5 mm high, dark brown and resinous. They are attached at the base of the calyx tube and closely enfold its lower half.

There are no bracts and the stipules of the subtending floral leaves are scarcely enlarged.

* 7 Glenluss Street, Balwyn, Victoria. 3103.

The ovary and plump pod are pubescent and the long slender style breaks off the pod before maturity.

Flowering time is usually at its peak during the first two weeks in October.

*P. patellifolia* has been collected on several occasions, dating from 1969, on Mt. Arapiles. Mr A. C. Beauglehole (pers. comm.) believes its presence there is due to deliberate introduction by local people who were interested in the propagation and dispersal of native plants in the area.

SPECIMENS EXAMINED included: Black Range, *A. C. Beauglehole 5933,* 30.xi. 1963 (MEL 567162); Black Range, *M. G. Corrick 6131,* 23.xi. 1978 (MEL 1504376); Black Range, *Harold Smith,* xi. 1927 (MEL 503756) Type.

***Pultenaea densifolia* F. Muell. in *Trans. Vict. Inst.* 119 (1855).**

This is also a very rare species in Victoria, having been recorded from only three localities in the north-west. It also occurs in South Australia. *P. densifolia* is a rather rigid, divaricate shrub 30-50 cm high. The terete stems have whitish, scaly bark, visible only on older wood after the leaves and stipules have fallen.

The very tiny, alternate, crowded, broadly ovate or elliptic leaves are 2-3 mm long, 1-2 mm wide and glabrous except for a few scattered, long pale hairs on the margin. They are concave or conduplicate, with recurved tips and a tiny, weak mucro.

The distinctive, pale, papery, closely imbricate stipules are united and the margins are edged with long, curly hairs. On very young growth the stipules completely envelope and hide the stem.

The orange and deep purple-brown flowers are axillary and clustered at the tips of the branches. The standard is 8-9 mm high and 4-5 mm wide with pale

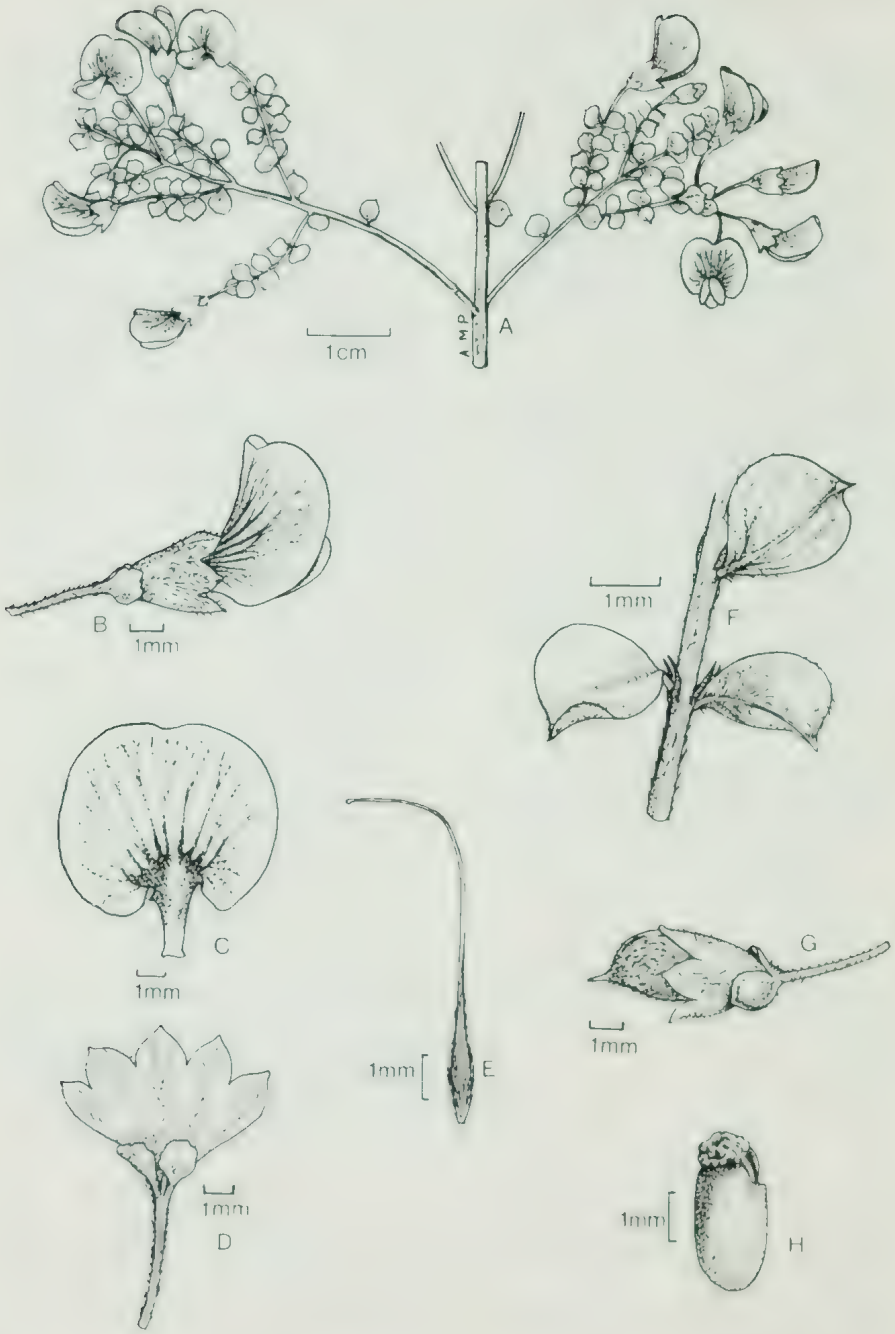



Fig. 21 *Pultenaea patellifolia*. A, habit; B, flower from side; C, standard; D, calyx showing bracteoles; E, ovary and style; F, section of stem with leaves and stipules, all from MEL 1504376; G, pod; H, seed from MEL 567162.

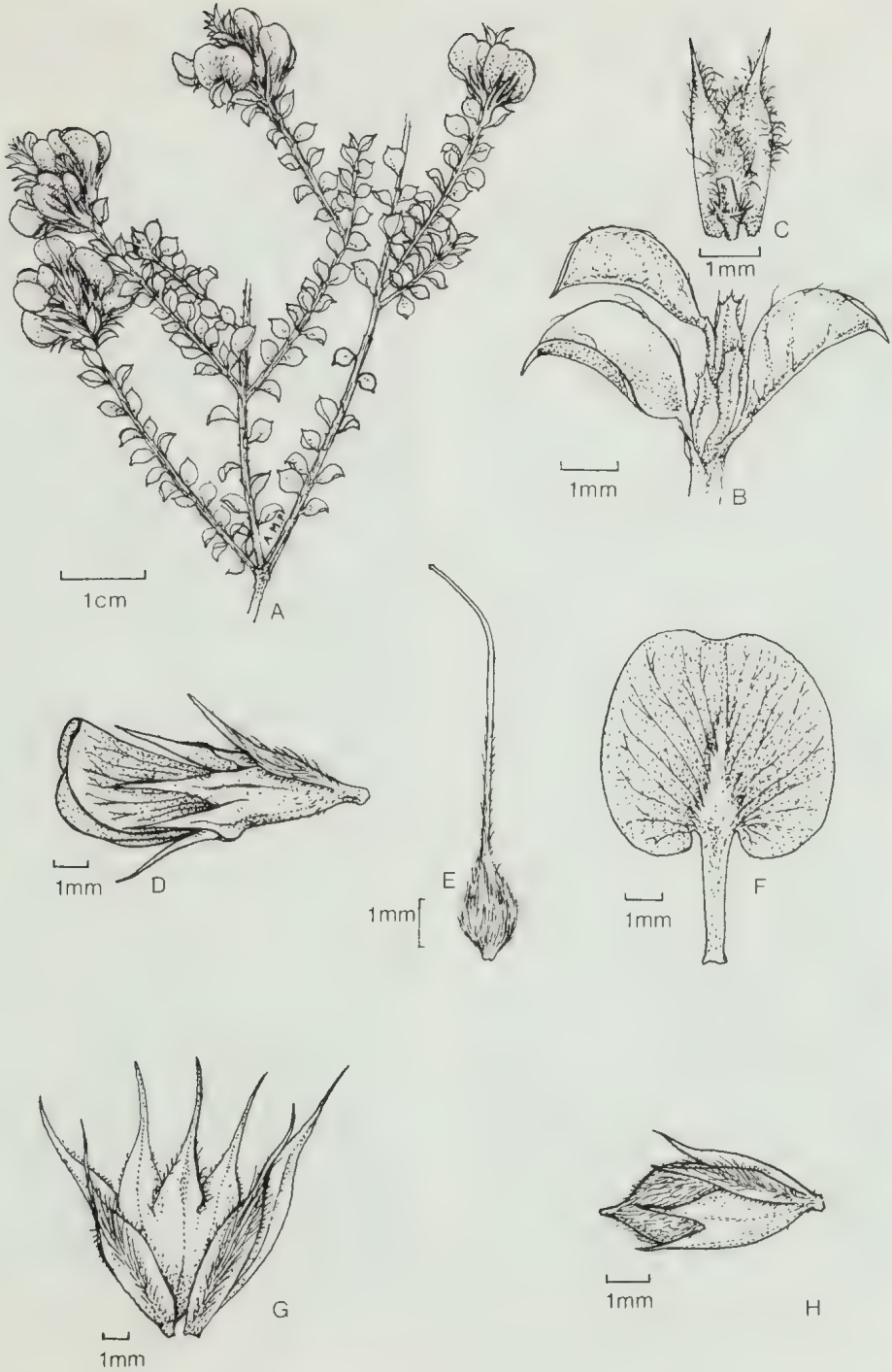
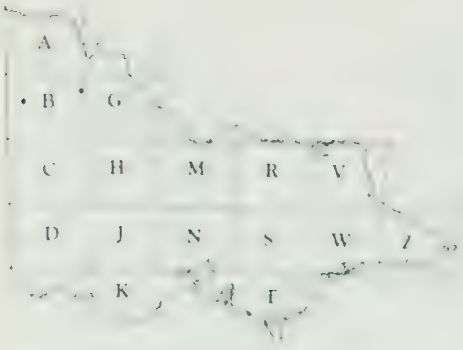



Fig. 22 *Pultenaea densifolia*. A, habit; B, section of stem with leaves and stipules; C, pair of stipules with leaf removed; D, flower from side; E, ovary and style; F, standard; G, calyx with bracteoles, all from MEL 567585; H, pod from MEL 1513585.




◆ *Pultenaea densiflora*

◇ *P. patellifolia*

Fig. 23. Known distribution of *Pultenaea patellifolia* and *P. densifolia* in Victoria.

orange and deep purple-brown blotches and lines in the centre. The wings are orange and the keel petals deep purple.

The calyx is 5-6 mm long with lanceolate lobes tapering into slender tips. It is glabrous except for the long, slightly curled hairs on the margins of the basal part of the lobes.

The lanceolate bracteoles are about 3-4 mm long with long pale hairs down the centre and short, curly hairs on the margin.

The leaves within the inflorescence are slightly reduced and have enlarged stipules which hide the calyx.

The rather short, thick, villous ovary tapers abruptly into a very long slender style with pale hairs extending along half its length.

The pod is plump, silky pubescent and not far exserted from the calyx.

Flowering time is late October to early November.

SPECIMENS EXAMINED included: Big Desert, south of Murrayville, *A. C. Beauglehole 57057* (MEL 1513585), 19.xi. 1977; Tintinara, S.A., *M. E. Phillips 500 and A. Sikkes* (MEL 567585), 21.x. 1966; Port Lincoln, S.A., *Wilhelmi* (MEL 35104) type.

**Acknowledgement:**

I am most grateful to Miss A. M. Podwyszynski of the National Herbarium of Victoria for preparing the accompanying illustrations.

## Cicadas Violate City Noise Ban

The noise made by cicadas in Stokes Valley on Friday night was measured at 80 decibels by an electronics engineer.

He said this is almost 100 times louder than the noise generated by an Upper Hutt factory which recently has been the subject of complaints from nearby residents.

Performance standards laid down in the Upper Hutt City Council's district scheme say noise generated after 7pm must not exceed 40 decibels.

The chirping and clicking noise made by cicadas was determined by a sound-level measure from the Tawhai Street house about 7pm.

The house backs on to bush, and outside the sound was 80 decibels.

Inside it was 50 decibels, three times more than the level allowed by the council. Decibels operate on a logarithmic scale.

The engineer compared this to the noise from a jet engine — 105 decibels — or 90 decibels from a pneumatic drill.

A cold snap last night quietened the insects down, and the engineer said that for the first time he could hear the clock ticking.

(**Editor's note:** this piece was taken from a Wellington, New Zealand newspaper and sent to the Naturalist by Mr Edmund Gill.)

# Tertiary Benthonic Foraminifera From Muddy Creek, Victoria

By K. N. Bell* and J. V. Neil**

This is the second paper dealing with the foraminiferal fauna from Muddy Creek, Hamilton; the first dealt with the planktonic fauna (Bell and Neil, 1982), this deals with the palaeoenvironment as shown by the benthonic foraminifera.

In his paper of 1889, Howchin listed 163 species and subspecies of benthonic foraminifera from the Lower Beds at Muddy Ck. His Lower Beds correspond to the present day Muddy Creek Marl (Miocene age) as distinct from his Upper Beds — now the Grange Burn Formation (Pliocene age). Although little was known at the time about the distribution of benthonic foraminifera in present day seas, Howchin made some suggestions as to the likely nature of the depositional environment of the sediments. He suggested that the foraminifera ". . . point to a higher temperature prevailing in the locality of their deposition than is proper to such latitudes in the present day. A very large proportion of specimens are characteristically tropical, and a decided majority . . . have their geographical range, in the present, restricted to the tropical and warmer temperate zones." (Howchin, 1889, p. 18.)

In this note we discuss in more detail the environments at Muddy Ck. as suggested by the benthonic foraminifera. No detailed faunal lists are given as the number of species found was not greatly different from Howchin's list (173 spp to his 163 spp) and the listings consist mainly of revised taxonomy. (Species lists can be obtained from KNB if required.) The distributional data on present day foraminifera are now better known and so can give more precise information on the Muddy Ck. deposits.

It must be remembered that foraminifera are only one element of the former complex biotope which the sediments now represent. The conclusions drawn from the foraminifera should be related to that provided by other animal groups (e.g. molluscs, ostracodes, corals, brachiopods, echinoids). Unfortunately such diverse information is not known.

Before the palaeoecology is discussed it should be pointed out that, as the samples were taken over a 15 cm (sample 7b) or 30 cm (samples 9, 5) vertical range, they represent a large time interval during which, of course, changes in the environment could have occurred. These changes would have the effect of mixing the various environmental faunas, so causing our deductions to be less precise.

Palaeoecology is the study of past environmental conditions. A fundamental assumption is that the fossil marine creatures lived in environments similar to those of their related species today (Lowman, 1949). The palaeoecology can be approached in two ways; (i) using generic determinations only, when a gross distribution (e.g. continental shelf, slope, estuarine, etc.) of the fauna can be made; and (ii) using specific determinations when a finer resolution of distribution can be made. In recent sediments, the identification of only a few of the commonest genera is sufficient to assign a sample to a particular depth zone (Culver and Buzas, 1981). There is no reason to suppose that such an approach would not hold for Tertiary sediments.

Firstly it is obvious that the sediments are marine; the large and diverse ben-

* Honorary Associate, Invertebrate Dept., National Museum of Victoria.
** 23 Michael St., Bendigo, Victoria.

Table 1.
Species recorded from Muddy Creek and Recent localities.
B, Bonthorpe; C, Chapman, Bass Strait; P, Collins, Bass Strait; R, Great Barrier Reef.

| | |
|---|---|
| *Siphotextularia concava* | B |
| *Dorothia minima* | C |
| *Gaudryina rugulosa* | BCPR |
| *Martinottiella communis* | P |
| *Cornuspira involvens* | BCPR |
| *Spirillina vivipara* | PR |
| *S. decorata* | R |
| *Amphistegina radiata* | BCR |
| *Articulina pacifica* | R |
| *Quinqueloculina subpolygona* | P |
| *Q. lamarckiana* | CPR |
| *Q. polygona* | BPR |
| *Biloculinella globula* | C |
| *Triloculina trigonula* | BCP |
| *Miliolina circularis* | BCP |
| *Miliolinella australis* | CP |
| *Amphicoryna scalaris* | CBR |
| *Oolina apiculata* | C |
| *Lagena laevis* | BPR |
| *L. sulcata* | PR |
| *L. elongata* | R |
| *L. marginata* | BC |
| *L. squamosa* | B |
| *Dentalina soluta* | CP |
| *Vaginulina elegans* | CP |
| *Patellina corrugata* | CPR |
| *Planularia australis* | P |
| *Robulus cultrata* | CR |
| *Guttulina regina* | BCPR |
| *G. yabei* | CP |
| *Sigmoidella kagaensis* | BP |
| *Globulina gibba* | CP |
| *Cancris auriculus* | BPR |
| *Svratkina australiensis* | P |
| *Eponides repandus* | CP |
| *Sphaeroidina bulloides* | BCPR |
| *Cassidulinoides chapmani* | P |
| *Cassidulina subglobosa* | BCP |
| *C. laevigata* | BPR |
| *Pullenia bulloides* | CP |
| *P. quinqueloba* | R |
| *Uvigerina canariensis* | BP |
| *Trifarina bradyi* | PR |
| *Reussella spinulosa* | BPR |
| *Bolivinella cf. pendens* | P |
| *Bronnimanni haliotis* | CPR |
| *Discorbis dimidiatus* | BCP |
| *D. bertheloti* | PR |
| *Rosalina bradyi* | P |
| *Astrononion australe* | P |
| *Anomalinoides macraglabra* | BC |
| *Heronallenia ligulata* | P |
| *Lamarckiana scabra* | R |
| *Pavonina triformis* | P |
| *Cibicides refulgens* | BC |
| *Dyocibicides biserialis* | C |
| *Elphidium crispum* | BCPR |
| *Glabratella australiensis* | P |
| *Gypsina vesicularis* | P |
| *Planodiscorbis rarescens* | PC |
| *Planorbulinella acervalis* | R |
| *Siphoninoides echinata* | R |
| *Cymbaloporetta squamosa* | R |

thonic and planktonic foraminiferal faunas indicate that open marine conditions prevailed. There is a marked decrease in the number of species on ascending the sequence — from 118 species in sample 9 to 71 species in sample 7b and only 53 species in sample 5. This decrease in fauna, both in species numbers and number of specimens, shows that a change of environment occurred, most likely a shallowing of the sea (Walton, 1964).

**Generic palaeoecology**

The presence in sample 9 of *Amphistegina* (1), *Articulina* (1), *Operculina* (1) and *Planorbulinella* (2) which, in present seas, are found in shallow, tropical waters, all point to warmer temperatures prevailing than those in present Southern Australian waters. (Numbers in brackets are the number of species of each genus present.) Specimens of each are rare to very rare and usually worn, indicating transport from the living site to the depositional site. *Planorbulinella* (2) is characteristic of shallow (0-50 m), temperate to tropical waters, whilst *Amphistegina*, *Articulina* and *Operculina* are very shallow (5-20 m) components in Recent tropical waters. The large numbers of *Cibicides* (4), *Dyocibicides* (1), and *Rosalina* (1) show that algae may have been present as these genera are often found attached to plant fronds. Also, these genera, along with *Cassidulina* (6), *Brizalina* (3) and *Bulimina* (1), are

characteristic of the inner-middle continental shelf (about 30-100+ m). *Dyocibicides* has been found in Recent seas to occur mainly in less than 70 m depths, but specimens have been reported from several very deep stations (Brady, 1884).

*Quinqueloculina* (8) and *Spiroloculina* (3) are found in shallower waters, usually less than 40 m but range down to 100 metres. Those miliolids *(Triloculina, Pyrgo, Massilina* and *Biloculina)* which are characteristic of deeper (greater than 100 m) waters are infrequent in the Muddy Ck. samples.

One species of *Globulina* is present, a genus which is restricted to waters less than 60 m deep and which also indicates a temperature warmer than that at present.

The lagenid fauna, comprising the genera *Lagena* (9), *Oolina* (3), *Fissurina* (2) and *Nodosaria* (2) is very large. These genera are indicative of offshore sediments, usually less than 180 m.

*Spirillina* (5) ranges from 0-100 m in present seas.

Deeper waters are indicated by the genera *Uvigerina* (4) (100+ m), *Cancris* (1) (50-150 m) and *Pullenia* (2) (greater than 250 m). However, apart from the uvigerinids, the other two genera are represented by very few specimens.

**Specific palaeoecology**

Very few species have apparently ranged from the Middle Miocene to the Recent. This makes the specific comparision with modern faunas more difficult. Nevertheless, when compared with Collins' (1974) Port Phillip Bay faunas, 42 species (25% of fauna) from Muddy Ck. are conspecific with modern Bass Strait faunas occurring near Port Phillip Heads. One species of special interest is *Bolivinella pendens* (Collins 1974). Originally described from the Bass Strait entrance to Port Phillip Bay, it was previously only known from the type locality. Recently Hayward (1982) described *B. bensoni* from the Altonian (Miocene) of New Zealand as being the possible progenitor of *pendens*. Our material does not allow us to distinguish between these two species.

Similar percentages are found when the Muddy Ck. fauna is compared with the faunas listed for the 120 m level for Bass Strait by Chapman (1941) and for the 66-130 m levels of the "Bonthorpe" dredgings from the Great Australian Bight (Chapman and Parr, 1935). In each case though the Muddy Ck. fauna shows a greater number of species of miliolids and lagenids, and an absence of deeper water arenaceous species, suggesting depths at the shallower end of the range.

The fauna has been compared with that of present tropical seas. Using the listed fauna for the Great Barrier Reef (Collins, 1958) where 391 species were found in shallow (reef flats) to deep (384 m) samples, 29 species from Muddy Ck. were in common. Of these only eight (4% of the Muddy Ck. fauna) were not also recorded from Bass Strait. These species then point towards warmer, but not tropical, temperatures prevailing.

Table 1 lists the species common to Muddy Ck. and these other localities.

The number of species falls off markedly upon ascending the stratigraphic section. Those disappearing are species characteristic of deeper water e.g. *Uvigerina, Pullenia, Textularia* and *Pyrgo*. At the same time the entrance of *Pavonina triformis, Gypsina vesicularis* and *Hauerina* sp. all point to shallower, warmer waters.

**Conclusions**

From such a study as this we can gain some idea of the conditions occurring when the Muddy Creek beds were deposited some 15 million years ago. In general the data indicate open marine conditions prevailing with depths about 60-100 metres (inner-middle continental shelf) in sample 9, with shallower areas

not too far away, and a slightly higher water temperature than at present found in Bass Strait. As deposition continued, the seas became shallower (inner continental shelf). There is little to suggest that the conditions were tropical at the time.

We await with interest palaeoecological studies on other marine faunas from Muddy Creek.

REFERENCES


Bell, K. N. and Neil, J. V. (1982). Tertiary Planktonic Foraminifera from Muddy Creek, Victoria. *Victorian Nat. 99:* 9-11.

Brady, H. B. (1884). Report on the foraminifera dredged by H.M.S. "Challenger" during the years 1873-76. *"Challenger" Exped. Repts., Zool. 9:* 2 vols.

Chapman, F. (1941). Report on Foraminiferal soundings and dredgings of the F.I.S. "Endeavour" along the continental shelf of the South-east Coast of Australia. *Trans. R. Soc. S. Aust. 65:* 145-211.

Chapman, F. and Parr, W. J. (1935). Foraminifera and ostracoda from soundings made by the trawler "Bonthorpe" in the Great Australian Bight. *Jour. Roy. Soc. W. Aust. 21 (1934/35):* 1-6.

Collins, A. C. (1958). Foraminifera. *Great Barrier Reef Exped. 1928-29. Scient. Repts.*, vol. 6 (6).

Collins, A. C. (1974). Foraminiferida. Port Phillip Survey 1957-63. *Mem. nat. mus. Vict. 35:* 1-61.

Culver, S. J. and Buzas, M. A. (1981). Distribution of selected recent benthic foraminiferal genera in the western North Atlantic. Ch. 27 *in* Microfossils from Recent and Fossil Shelf Seas. (eds. Neale and Brasier), Ellis Horwood Ltd, Eng.

Hayward, B. W. (1982). Oligocene and Miocene Bolivinellidae (Foraminiferida) from New Zealand. *Alcheringa, 6 (1):* 43-55.

Howchin, W. (1889). The Foraminifera of the Older Tertiary of Australia. No. 1, Muddy Creek, Victoria. *Trans. Roy. Soc. Sth. Aust. 12:* 1-20.

Lowman, S.W. (1949). Sedimentary facies in Gulf Coast. *Amer. Ass. Pet. Geol.*, Bull 33(12): 1939-1997.

Walton, W. R. (1964). Recent Foraminiferal Ecology and Palaeoecology *in* Approaches to Palaeoecology, eds. Imbrie, J. and Newell, N. (John Wiley and Sons, Inc. N.Y.).


---

## Major Corrections to the "F.N.C.V. Excursion to Flinders Island", 13th to 20th January, 1980. (*Victorian Naturalist, 98:* 163-168, July-August, 1981).

For each correction the page number is followed by the paragraph and sentence number. Some minor mispellings of scientific names are excluded from this list of corrections because the intended species are plain enough.

164,2,2. Furze Hake *(Hakea ulicina)* occurs further south in the Furneaux Group but does not reach the Tasmanian mainland.

164,4,3. Flinders Island, not Summer Camp, was used by hunters for over a hundred years.

165,1,2. Change Hard Water-fern *(Blechnum procerum)* to Soft Water-fern *(Blechnum minus)*.

165,2,2. The Leucopogon esquamatus was found, not on The Dutchman, but on the road verge of the first rise south of the West End turnoff.

165,5,2. Change "in 1872" to "by 1872".

165,5,3. Change "in 1860" to "by the 1830s".

165,5,4. Note that Creeping Saltbush was found only on the north end of Green Island Reef.

165,7,2. Change to "Muttonbirding has taken place in the Furneaux Group since at least 1825".

165,7,3. Change to "Below the burrows was a processing shed used formerly by the owner of the island".

166,1,1. Note that the Goosefoot and Peppercress were found only at the north end of Green Island Reef, the exposed reef referred to here. Also we found some Black-faced Cormorants breeding there, not just one.

166,2,7. Change "a Star-hair (*Astrotricha* sp.)" to "Coast Groundberry *(Acrotriche cordata)*".

166,4,1. No Wirilda occurs at the Tanners Bay Mines.

166,5,3. I have never recorded Black Sheoak here and suspect that the species found was the common *Casuarina monilifera*.

166,6,2. We found Coast Beardheath *(Leucopogon parviflorus)* not Swamp Beardheath.

167,1,2. The Sea Celery we found is now known as *Apium insulare.*

167,2,6. Replace "Black Sheoak" by "Drooping Sheoak *(Casuarina stricta)"*

168,1,1. The Water Plantain *(Alisma plantago-aquatica)* has not previously been recorded for Tasmania and, in the absence of a specimen, the record is doubtful.

168. Because the bird list includes records for Flinders Island, Green Island (Big Green Island) and Green Island Reef, the heading should be changed to BIRDS SEEN DURING THE FLINDERS ISLAND EXCURSION 13th to 20th January, 1980. The breeding Shearwaters (Muttonbirds) and Penguins were found on Green Island, while Black-faced Cormorants, Sooty Oystercatchers and Pacific Gulls were found breeding at the northern end of Green Island Reef. As I have neither record nor memory of any breeding Caspian Terns, this species should be changed to a non-breeding record.

**J. S. Whinray, Flinders Island, 7255.**

---

## A Wallaby Wave-catcher

On 31st December last, my wife and I were sitting on a beach approx. 14 miles past Lorne at about 10.30 in the morning. To our surprise, we noticed a black swamp wallaby hopping along the beach towards us. It then hopped over some low flat rocks and into the shallow water. For about 20 minutes, it stayed within 25 metres of the edge, jumping in the waves and every now and then moving out to about 25 metres and "surfing" in to the beach.

After 20 minutes, it suddenly swam out past its previous limit and, despite some reasonably large waves, continued out until we estimated it would be 150 metres from the beach. Here it remained with its head just visible between waves.

After about 15 minutes, it began to move slowly back towards the beach. Two skin-divers who had joined us to watch said that it may have some difficulty getting back as there was a strong undertow in the area. Eventually, a large wave half-washed the wallaby into the shallow water where it was knocked, although probably not heavily, against some rocks.

It appeared to become entangled in some kelp but, in any event, the effort of regaining the beach was too much and it lay floundering in the shallow water.

We dragged it up to the dry sand where it lay barely conscious. After some time, we tipped it up to drain the water from its lungs and carried it into the thick scrub behind the beach.

About 1½ hours after bringing it from the water, it was able to stand upright and move slowly, but not hop.

The only explanation we have heard for its behaviour in going so far from the shore was that kangaroos and wallabies occasionally enter very deep water to get rid of (? by drowning) fleas. We noticed that this wallaby had a few ticks under its neck.

* * *

Mr M. S. W. Richards of Armadale, Victoria, who forwarded this note enclosed the following letter.

"I enclose a note of an observation made by my wife and myself (members of the F.N.C.V.) over the Christmas holidays and thought it may be of interest to your readers. On the other hand, it may be a common occurrence which we have not been lucky enough to have seen before. We would, however, be interested to know the likely reason for the wallaby's behaviour and also its chances for survival (pneumonia etc.) after we left it."

# The Victorian Mygalomorph Spider *Stanwellia grisea* (Hogg 1901)

By A. E. Spillane*

*Stanwellia grisea* (Hogg 1901), subfamily Diplurinae, is a mygalomorph spider, and belongs to the family Dipluridae.

The synonym by which *S. grisea* was known for many years, was *Aname butleri* Rainbow and Pulleine 1918, "The Melbourne Trapdoor Spider". It was transferred to *Stanwellia*, when Dr Barbara York Main of Western Australia revised the genus.

Six different species of spiders from the genus *Stanwellia* Rainbow and Pulleine are recognized from Australia. The genus is represented in Western Australia, South Australia, Victoria, New South Wales and Tasmania (Main 1972).

**Sub-order Mygalomorphae**

Mygalomorph spiders are of a very ancient lineage, their phylogeny extending back millions of years. The main distinguishing feature of this type of spider, are its par-axial chelicerae — unlike the chelicerae of a modern true spider — which are di-axial.

The spiders occur in all continents, but their main environments are in tropical and temperate regions. The sub-order is well represented in both zones in Australia.

**Description and natural history of *Stanwellia grisea* (Hogg 1901)**

The spiders grow to a fairly large size; body lengths-excluding legs and chelicerae — of about 21 mm are not uncommon. Their colour is rather variable; it ranges from a glistening gold, to a very dark brown. The amount of hair is also variable; some specimens are covered with a thick pubescence, others are sparsely covered.

* 99 Rutland Avenue, Mount Eliza, 3930.

Spiders belonging to this species construct silk-lined tunnels in which they live. The tunnels are usually open at the entrances — they never have trapdoors. Two tunnels belonging to these spiders were examined recently; both were 21 cm in length, and their diameters were 13 mm and 17 mm.

By living in the ground the spiders maintain the humidity that has been an essential part of the environment of mygalomorph spiders for millions of years. Like other spiders of the sub-order to which they belong, they are very susceptible to desiccation; consequently, the females spend most of their lives in their tunnels. In contrast to this behaviour, the mature males, at certain times of the year, wander about under the veil of night when they are searching for the nests of females.

My garden appears to be a suitable habitat for mygalomorph spiders, as specimens of *Stanwellia grisea* are observed fairly frequently. The garden — which is about the size of two building blocks — is semi-cultivated, and is well covered with indigenous and exotic trees and shrubs. Tunnels belonging to *S. grisea* have been observed in a large variety of situations, including under logs and stones, in natural humus, and inside postholes next to the posts.

Between 23 July, 1978 and 12 April, 1982 thirty seven *S. grisea* spiders were found on the property. Thirty four were females and three were males. The largest specimen found was a female; it was aggressive, very robust, and appeared to be quite old. Its body length was 23 mm. The number of cuspules on the labiums of the specimens examined (a diagnostic feature of the genus), varied from three to seven.

Twenty one females and one mature

Fig. 1. A female *Stanwellia grisea* (approximately 2x). (Photo: author).

male of the above specimens, were discovered living in a colony when a heap of garden debris, covering an area approximately three square metres by half a metre high, was removed. Some of the nests were only a few centimetres apart. The male in the colony was found on 24 July, 1979.

On the evening of 10 April, 1981, a wandering mature male was found on the back porch of the house.

The last specimen found was a mature male; it was found wandering in the house on the evening of 12 April, 1982, presumably searching for the nests of females. Its body was covered with a dense golden pubescence, that concealed the yellowish blotches on the dorsal surface of the abdomen. These blotches are usually a conspicuous feature of the spiders. It is interesting that both wandering males were observed in April, as it has been deduced that *Stanwellia* males wander and mate in the autumn (Main 1972).

It is estimated, that on 23 July, 1978 — the day that the survey commenced — the property would have contained approximately forty five mature *S. grisea* spiders.

These unobtrusive and interesting spiders, which have such an ancient history, must play a very useful role in helping to keep down the numbers of many of the smaller ground frequenting members of the animal kingdom.

**Acknowledgment**

I am greatly indebted to Dr Barbara York Main for her most helpful suggestions and advice in the preparation of this paper.

REFERENCES

Butler, L. S. G. (1933). The Common and Conspicuous Spiders of Melbourne. *Victorian Nat. 49:* 271.

Main, B. Y. (1967). *Spiders of Australia.* Jacaranda Press, Brisbane.

Main, B. Y. (1972). The Mygalomorph Spider Genus *Stanwellia* Rainbow and Pulleine (Dipluridae) and its relationship to *Aname* Koch

and certain other diplurine genera. *J. Roy. Soc. West. Aust. 55:* 100-114.
Main, B. Y. (1976). *Spiders.* Collins, Sydney
Rainbow, W. J. and Pulleine R. H. (1918). Australian Trapdoor Spiders. *Rec. Aust. Mus.* 7, No. 7.
Wakefield, N. A. (1967). *A Naturalist's Diary.* Longmans, Melbourne.

## A Kinglake Bird List

(Birds observed within a radius of about six kilometres from the F.N.C.V. property, 1946-1982.)

By J. L. Provan

PAINTED QUAIL (Occasional)
SPOTTED TURTLE-DOVE
COMMON BRONZEWING
BRUSH BRONZEWING
LITTLE PIED CORMORANT
AUSTRALIAN PELICAN (Occasional flocks overhead)
AUSTRALIAN SPUR-WINGED PLOVER
AUSTRALIAN WHITE IBIS
STRAW-NECKED IBIS
WHITE-FACED HERON
WHITE-NECKED HERON
MANED GOOSE (WOOD-DUCK) (Regularly visits big dam west of road a few kilometres down northern slope)
SWAMP HARRIER
AUSTRALIAN GOSHAWK
COLLARED SPARROWHAWK (Occasional)
WEDGE-TAILED EAGLE (Fairly regular)
WHISTLING EAGLE (Occasional)
AUSTRALIAN BLACK-SHOULDERED KITE
LITTLE FALCON
BROWN HAWK
NANKEEN KESTREL
BOOBOOK OWL
LITTLE (?) LORIKEET
YELLOW-TAILED BLACK COCKATOO
GANG-GANG COCKATOO (Not so common in recent years)
WHITE COCKATOO (Regular inhabitant in recent years)
CRIMSON ROSELLA (Common)
BUDGERIGAH (Seen once — flock of about six on northern slope, Dec. '45)
TAWNY FROGMOUTH
LAUGHING KOOKABURRA
SACRED KINGFISHER
SPINE-TAILED SWIFT
PALLID CUCKOO
FANTAILED CUCKOO
BRUSH CUCKOO
HORSFIELD BRONZE-CUCKOO
GOLDEN BRONZE-CUCKOO
SUPERB LYREBIRD
WELCOME SWALLOW
AUSTRALIAN TREE-MARTIN
GREY FANTAIL (V. com. in summer)
RUFOUS FANTAIL (C. summer)
WILLIE WAGTAIL
SATIN FLYCATCHER (Summer)
SCARLET ROBIN
FLAME ROBIN
PINK ROBIN (Rare — Island Creek)
ROSE ROBIN (Rare)
EASTERN YELLOW ROBIN (C.)
GOLDEN WHISTLER
RUFOUS WHISTLER (Mainly summer months)
OLIVE WHISTLER
GREY SHRIKE-THRUSH
MAGPIE-LARK
EASTERN SHRIKE-TIT
EASTERN WHIPBIRD
BLACK-FACED CUCKOO-SHRIKE
CICADA BIRD (JARDINE CATERPILLAR-EATER) (Seen once — Dec. '46)
WHITE-WINGED TRILLER

SPOTTED QUAIL-THRUSH
BLACKBIRD
GROUND THRUST (SCALY THRUSH)
STRIATED THORNBILL (C.)
LITTLE THORNBILL (Island Creek)
BROWN THORNBILL (C.)
BUFF-TAILED THORNBILL
YELLOW-TAILED THORNBILL
WHITE-BROWED SCRUB-WREN
LARGE-BILLED SCRUB-WREN (R. Island Creek)
CHESTNUT-TAILED GROUND-WREN (HEATH-WREN) (Resident summer, '46-'47; not positively identified since)
PILOT BIRD
SUPERB BLUE WREN (C.)
WHITE-BROWED WOOD-SWALLOW (Passes over ocasionally)
DUSKY WOOD-SWALLOW
ORANGE-WINGED SITTELLA
WHITE-THROATED TREE-CREEPER (C.)
RED-BROWED TREE-CREEPER
MISTLETOE-BIRD
SPOTTED PARDALOTE
RED-TIPPED PARDALOTE (EASTERN STRIATED PARDALOTE ?)
GREY-BACKED SILVEREYE
WHITE-NAPED HONEYEATER
BROWN-HEADED HONEYEATER
EASTERN SPINEBILL
FUSCOUS HONEYEATER (Island Creek)
YELLOW-FACED HONEYEATER
WHITE-EARED HONEYEATER
CRESCENT HONEYEATER
YELLOW-WINGED HONEYEATER (Common near Island Creek when Banksias are flowering)
RED WATTLE-BIRD
AUSTRALIAN PIPIT
RED-BROWED FINCH
HOUSE SPARROW
GOLDFINCH
GREENFINCH
OLIVE-BACKED ORIOLE
STARLING
INDIAN MYNA
AUSTRALIAN RAVEN
LITTLE RAVEN
WHITE-WINGED CHOUGH
PIED CURRAWONG (C.)
GREY CURRAWONG
BLACK-BACKED MAGPIE
WHITE-BACKED MAGPIE (C.)

(Total — 105 species, but there will be more to come!)

---

## Orchids

Mrs Hilary Weatherhead has forwarded part of a note from Miss Jill Rossiter written to Mr Allan Morrison which deals with some orchids in the Warby Ranges. It says "We have found two more orchids in the Warby Ranges which have not been recorded there before, *Pterostylis parviflora* (Tiny Greenhood) and *Prasophyllum despectans* (Sharp Midge-orchid).

Some of us are collecting specimens for Cliff Beuglehole to help with the check list that he hopes to make of the area".

# The Seedling of *Trithuria* (Hydatellaceae).

By D. A. Cooke*

## Introduction

*Trithuria submersa* J. D. Hook, is the only Victorian representative of the flowering plant family Hydatellaceae. The seeds of this family have a characteristic anatomy, with a two-layered testa formed from the two integuments of the ovule. The outer layer is uniformly thick and rigid; the inner is thinner, but is thickened to form an operculum over the small apical embryo (Hamann et al., 1979). As the germination of seeds of Hydatellaceae has not previously been described, the function of this structure has been unknown.

## Methods

Seeds were placed on wet filter paper in two petri dishes. One replicate was first refrigerated at 2°C for 16 days; both replicates were incubated at room temperature.

Voucher: Near abandoned gold mine 16 km W of Maryborough P.O., 26 Oct. 1981, *A. C. Beauglehole 69473* (MEL; Maryborough FNC 816).

## Results

Germination was observed in both replicates after 50 days at room temperature.

The larger part of the seed, containing the perisperm, shows no change as water is taken up, but the embryo undergoes a great increase in volume within the distensible inner layer of the testa, forming a bulge at the apex of the seed. The cells of the rigid outer layer separate, remaining visible as dark spots on the surface.

As the operculum is the thickest region of the inner testa, the weaker zone surrounding it stretches and the bulge elongates rather than bursting at the apex. The primary leaf and the radicle erupt behind the operculum through the upper and lower sides respectively. The cotyledon forms a part of the tissue remaining inside the testa and does not become green.

With further growth, the hypocotyl from which the radicle arises emerges from the seed. As the seed is never raised above the substrate by the developing seedling, germination is hypogeal.

## Discussion

The germination requirements of *Trithuria submersa* are typical for a winter annual adapted to a summer-dry climate. A wet period, as would occur at the beginning of the growing season in autumn, is needed to break seed dormancy. There is no stratification requirement, since the coldest period of the year forms a part of the growing season.

Seedling morphology emphasizes the distinction made by Hamann (1976) between Hydatellaceae and Centrolepidaceae. In the latter family germination is epigeal, the seed being raised above ground on the tip of the green cotyledon (Hieronymus, 1873).

**Acknowledgements**

Thanks are due to the Director and staff of the National Herbarium of Victoria, where this work was carried out.

* 9/51 Marne St., South Yarra 3141.

REFERENCES

Hamann, U., (1976). Hydatellaceae — a new family of Monocotyledoneae. *New Zealand J. Bot.* 14: 193-196.

Hamann, U., Kaplan, K. and Rübsamen, T., (1979). Über die Samenschalenstruktur der Hydatellaceae (Monocotyledoneae) und die systematische Stellung von Hydatella filamentosa. *Bot. Jahrb. Syst.* 100: 555-563.

Hieronymus, G., (1873). Beiträge zur Kenntniss der Centrolepidaceen. *Abh. Naturf. Ges. Halle* 12: 115-222.

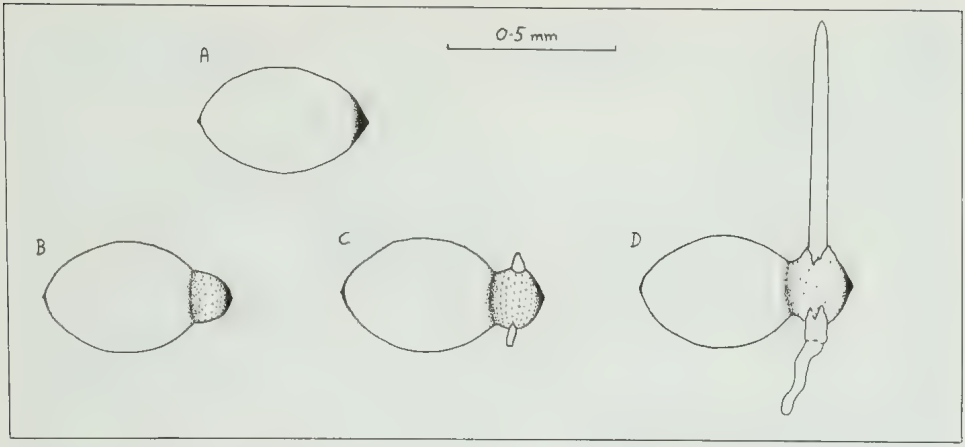



Fig. 1.
A — Seed.
B — Operculum distended by developing embryo.
C — Emergence of first leaf and radicle.
D — Seedling at about 60 days.
All X40.

# The Derrinal Permian Glacial Valley Part 4†

BY FRANK ROBBINS*

**The Wild Duck Creek area**

This is one of the most interesting parts of the glacial area (see Fig. 8 and Fig. 2 in previous issue). Actually, it is really a separate smaller glacial valley on the eastern side of the Wild Duck Ck., and it fed into the main glacier (on W side of Wild Duck Ck.) round about today's junction of this creek with Mt. Ida Ck. This narrow glacial valley occupies an anticline obviously plucked out by the ice in the general direction of the strike of 330° T, i.e. the bottom ice direction at least followed the strike direction, and the source of its ice would be from the high Ordovician country to the south of Mrs E. L. Adair's. I have no doubt that the ice was thick enough to over-top all the Ordovician landscape from Adair's to Campbell's and Hill's property on the following evidence (a) The presence of one glacial pavement on a vertical face on the highest parts of the plateau in Hill's property, together with erratics and a number of smoothed faces and rounded basement rocks on which we could find no evidence of glacial striae (see Fig. 8); (b) The high rounded hill in Campbell's immediately west of the large number of pavements found, had a shape as if ice-formed; (c) Pavements Nos. 9 and 10 in Hill's showed striae more easterly than others suggesting ice from the main glacial valley west of the present Wild Duck Ck. was flowing over the Ordovician ridge between. Thomas' Heathcote map (1940) had shown this area as down-faulted glacial between two parallel faults. Our discovery of numerous glacial pavements along the edges, particularly the western, changed it to a narrow ice-carved U-shaped valley. Altogether, we found by excavation about 40 striated pavements of which 20 were worthy of special note. Of course, after photography in both mono and stereo colour, we have back-filled them all (except 2 in Adair's — I forgot?) to protect the striae from weathering, and these articles are written to preserve what we discovered in case some future worker wants to know where the evidence is hidden.

† Continued from page 39 in the last issue.
* 81 MacKenzie St, Bendigo, Vic. 3550

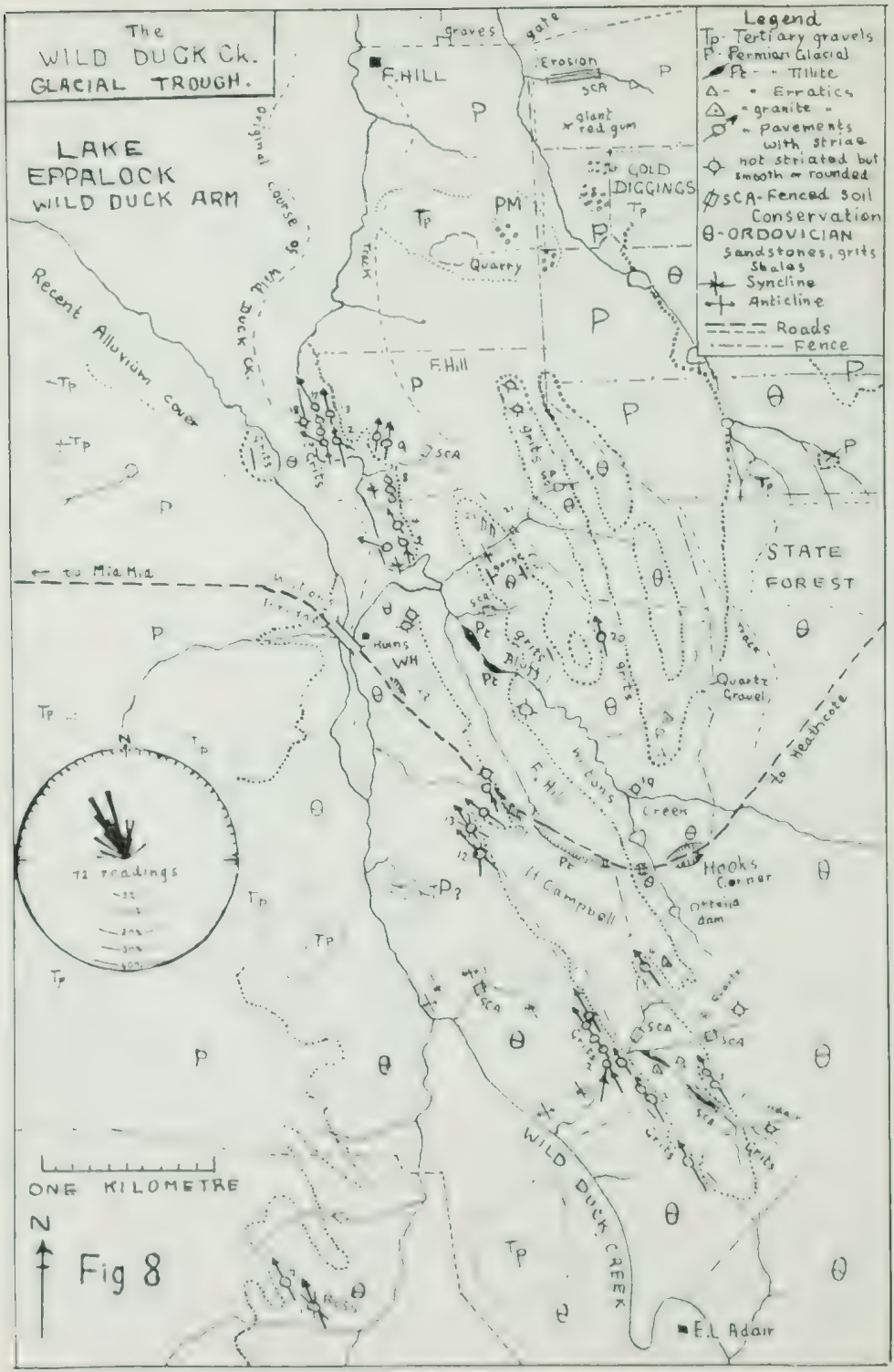

The
WILD DUCK Ck.
GLACIAL TROUGH.
LAKE
EPPALOCK
WILD DUCK ARM
Legend
Tp- Tertiary gravels
P- Permian Glacial
Pt - " Tillite
Erratics
" granite "
" Pavements with striae
not striated but smooth & rounded
SCA-Fenced Soil Conservation
O-ORDOVICIAN Sandstones, grits Shales
Syncline
Anticline
Roads
Fence
F.HILL
Erosion
SCA
giant red gum
GOLD DIGGINGS
Quarry
Recent Alluvium cover
F.Hill
STATE FOREST
to Mia Mia
Huons WH
Quartz Gravel
to Heathcote
Hooks Corner
Ortelia dam
W. Campbell
Creek
72 readings
ONE KILOMETRE
N
Fig 8
WILD DUCK CREEK
E.L Adair

Plate 1. View along Campbells glacial valley wall. Numbers refer to pavements in text. This remarkable photograph shows how ice moved northwards and collided with Campbells No. 2 cliff, was deflected around the corner and up the hill yet the striae are still visible after 250 million years on the cliff side.

**The glacial pavements of the Adair-Campbell-Hill trough** — I numbered them in order starting at the south end in Mrs E. L. Adair's through H. Campbell's to F. Hill's in the north, first along the W side, then returned along the E side of the trough.

No. in Adair's = 6 (3 on each side).

In Campbell's — 16 — all on W side, of which 3 at the north are off-set to the E.

In Hill's — 20 + a number of suspect glacially smoothed rocks marked in Fig. 8.

Permission from owners is needed before entry. Hill's can be explored from the main road, but I always take visitors into Campbell's for best viewing, but this is unwise once the ground has become soft.

**Notes on the pavements** — I have photos of most of them, including many stereo colour pairs (can only be viewed with my special high power viewer), also line drawings of all of them, and special larger scale locality maps or drawings that would enable anyone to find where we had buried them. But a "guide who knows" would be better. I will mention them in order, starting in the extreme south in Mrs Adair's on the W side, then in order right through to the north in F. Hill's.

**Adairs Nos. 1,2,3** — not described (see Fig. 8).

**Campbells No. 1** — big sandstone bar in the middle of Campbells Gully where water continually runs over it — off-set to the E as would be expected in a U-shaped glacial valley — striae absent except under the mud-covered bank.

**Campbells No. 2** — rather unique in that (see Plate 1) it appears that Campbells Gully must have been there before the ice came down the hill and collided with the cliff-like northern bank. Pressure of the ice caused the west-dipping strata striking at 330° T to bend round to 278° T, and the ice, being forced to move to the right around the corner, scratched the vertical face (3 m or 10 ft. high) horizontally from 008° T round to 330° T. It also rounded, smoothed, and scratched the top, seen clearly using binoculars. When I first found this remarkable cliff in early 1968, the vertical face was nearly all lichen-covered, yet the glacial striae still showed clearly through it, whereas the rounded striated top

was mostly clear of lichen. I luckily got a close-up photo using J. K.'s 225 mm lens on 17.9.68, but I think the lichen has now covered it. One would need a rope ladder to get up to it to see if lichens protect or destroy striated surfaces.

It puzzled me why the glacial striae on Campbells No. 2 Cliff after 250 million years, had not weathered away long ago. Nearly everywhere in our area, we had to dig to get perfectly preserved glaciated surfaces. My only guesses were that a S-facing cliff is protected from the sun, or lichen protected it (I always thought the opposite), or the hard grits (see Fig. 8) of Campbell's prominent hill on the north side helped or maybe the Campbells Gully had migrated north-wards, in the same way as I had suggested in Part 2 for the Mt. Ida Ck., since the southern (left) bank has a much gentler rise in profile. Thus Campbells No. 2 cliff could have been only recently uncovered of post-Permian deposits e.g. soil etc.

May I add that a little further down this gully, there is a conspicuous U-shaped gap in the north bank rocks whose dip then changes to east, indicating a syncline. (Fig. 8) It may have had a soft centre which just weathered out or was even removed by the ice which once must have flowed over the hill here. About 1.3 Km NW in Fig. 8 marked P?, we found erratics supporting this idea that Permian ice did flow this way, although we realised SCA machinery could have dropped them there. Also, I photographed near the gap in the creek bed a big sandstone rock with beautiful parallel striations, not due to ice action, but merely the stratification structure. We had learned by now how to tell glacial striae from others.

**Campbells No. 3** — 5.5 m (6 yd.) further N round the corner — a hard rounded lichen-covered sandstone 3.1 m (10 ft.) long — on excavating down 60 cm. (2 ft.) — very well striated by ice forcing its way round — 2 crescentic gouges and striae intersecting. Another large suspect rock above this one.

**Campbells No. 4** — 1 m further on — 1 m long — a vertical undercut face well lichen-covered, yet showing glacial striae through it.

**No. 5** — 6.4 m (7 yd.) further N — about 9 m (29 ft.) long × 1.5 m (5 ft.) wide — piece missing — excavation at N end gave an outstanding clear striated pavement — one good crescentic gouge — faint striae on exposed parts — See Plate 2.

**No. 6** — 15 m (16 yd.) further N — 7.3 m (24 ft.) long by 3 m (10 ft.) wide — a missing piece and ant's nest at S end — faint striae and lichen on exposed part — excavation at N end 2.8 m (9 ft.) long × 60 cm (2 ft.) deep very well striated.

**No. 7** — 84 m (92 yd.) further N and well off-set to E from line of previous pavements along the Ordovician wall, as would be expected in a U-shaped glacial valley — this is really a spectacular pavement rivalling Dunns Rock. Sometimes we uncover this rock to show VIP (v. impt. people) visitors, then we make them cover it up again. It is 7.3 m (24 ft.) long × 1.5 m (5 ft.) wide, and we excavated the N end as well as the full W side. (see Plate 3)

**No. 7a** — on one occasion, we pointed to a suspect 29 m (31 yd.) long rounded rock 5 m (16 ft.) W of it, and still 6.4 m (7 yd.) off-set from the main wall. We suggested they uncover the S end for us. It was very well striated under the soil.

**No. 8** — 50 m (54 yd.) N of No. 7 — not spectacular — 2.4 m (8 ft.) long — broken into 7 pieces with striae still visible.

**No. 9** — 4.6 m (5 yd.) beyond No. 8 — rather curious — 0.9 m (3 ft.) long with curved vertical face with numerous vertical striae, and 2 faint horizontal striae at the usual 330° T direction — an obvious crescentic gouge on its face also. I have no explanation for the curved vertical striae, but I have seen vertical striae on a glaciated face in a quarry at Tookyayerta Ck., Fleurieu Peninsula, S.A.

**Nos. 10 and 11** — omitted — inconspicuous — one on hill-top.

**No. 12** — on N end of a sandstone boundary outcrop 1 Km from Campbells Gully — near fence on W — striae 322°-340°T.

**No. 13** — an excellent example of a hard sandstone bar obstructing ice, which rounded, polished and striated it in a similar radiating manner (294°-328°-351°T) to that of Farleys No. 4 — this bar off-set to E of No. 12 — the southern part plucked out by ice, caused obstruction by the rest. Further E, numerous erratics including granites, were followed by an arcuate line of Ordovician, suggesting an anticline.

**No. 14** — a sandstone in this line had a quartz vein ground down to a polish — in reflected light and wetted, it showed microscopic striae at about 314°T.

**No. 15** — omitted — badly broken and displaced?.

Plate 2. Campbells No. 5. Ice moved from the top left hand corner to the bottom right hand one.

**No. 16** — S side of highway — faint striae at 340°T.

*Wiltons Hill* — WH on map — named after a "character", Wilton, who lived near Wiltons Bridge over Wild Duck Ck. (ruins on map). It is a rounded Ordovician hill suggesting it was shaped by over-riding ice. A small Tertiary quartz gravel capping (Tp), indicates once the whole glacial area was buried by post-Permian deposits derived from the higher Ordovician country adjacent to the Derrinal Valley. The quartz indicates a low level in the Tertiary terrain.

On the E side of Wiltons Hill is a sudden steep drop from Ordovician to Permian glacial. We expected to find glacial evidence all along this wall, but we found no evidence of smoothing or striations despite several excavations. All we found was a suspect rounded **Hills No. 1a** block near the highway, and 2 elongated exposures **(Nos. 1b & 1c)** like what to expect if ice-shaped at the wall's N end. No striae could be found but No. 1 b appeared to have a central finely contorted region of a syncline. Opposite to them on the other side of the gap eroded by Wiltons Ck. is an obvious wide open syncline, and on the E leg (W dipping) we found:

**Hills Nos. 2a,2b,2c,2d** — 4 separate close strata striking at 347° T. The ice had bevelled these off at about 325° T, leaving the northern ends striated, i.e. these were again pavements on the W side of this feeder valley in Hill's area.

**Hills 4,5,6,7,8** — really a beautifully clear boundary of W dipping Ordovician rocks adjacent to Permian glacial deposits on the E side. An aerial photograph (by helicopter) would show beautifully, how the ice had bevelled off the N or S ends of the individual strata. (See Plate 4) The ice along here would not have been guided by the strike of the basement strata as it was in Adair's and Campbell's.

**Hills 9 & 10** — two prominent hard sandstone pavements a little way inside the Permian boundary, noteworthy for showing by their N.E striae (2°-9° T) that the ice must have overflowed the prominent Ordovician boundary from the main western glacier into Hills glacial valley. The long Ordovician outcrop from No. 2 to No. 10 ends a short distance further on under the Permian.

Plate 3. Campbells No. 7. North view.

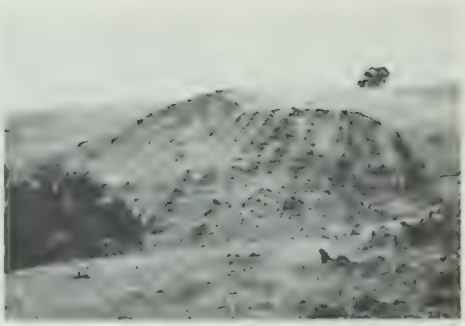


Plate 4. Hill's property. Photograph shows how ice had levelled off the vertical Ordovician strata at an angle to the strike.

**Hills 12 & 13**
**Hills 14,15,16,17** }
— these are 2 other parallel lines of Ordovician outcrop which begin and end a short distance W of the previous outcrops. Just why this is so is not clear unless we assume they belong to the same lines as the Wiltons Hill Ordovician series, of which the ice could have removed rocks in the intervening gap, or perhaps the Wild Duck Ck., which recently occupied that gap, had undermined and removed them. It is common to find in the Derrinal region, strong steeply dipping Ordovician sandstones with discontinuities or gaps, as if sections of outcrops had been somehow removed. The more westerly line (Nos. 14 to 17) is characterized by a strong component of hard grits on which pavements Nos. 14,15,16,17 were found by excavation. The striae would average about 335° T, and always on the S to SE grit faces. *No. 12* — is a large sandstone 23 m (25 yd.) long well striated at 6 different places — mean 339° T but some at 295° T.

West of these 2 lines is a very steep drop down to F.S.L. of the lake. A little further N, all Ordovician outcrops end and do not reappear till further N beyond Mt. Ida Ck. and Forest Ck., and even then they are generally of low profile or completely hidden under recent alluvium or hill-wash.

Having traced the long line of glacial pavements along the W side from S to N, why do we find only 4 on the E side (3 in Adair's and 1 in Hill's high up on the edge of the plateau (see map).

**Adairs Nos. 5a,5b** — still uncovered 1983, but I hope to cover them someday — very clearly striated parallel to the strike (327°T) on the E dipping W leg of a syncline on the E side of this narrow glacial feeder valley i.e. the bottom ice was guided by the strike. No. 5b shows very good "stoss and lee" ice erosion in miniature.

**Adairs No. 4** — omitted — see map.

**Hills No. 20** — see map — on a vertical face high up on the plateau. Apparently the ice had travelled up this hill carving its way through gaps between lines of hard ordovician grits and sandstones striking 347°T. One large smooth suspect rock 7.6 m (25 ft.) long made us dig down 53 cm (21") for a 2.7 m (8¾ ft.) length, and, lo and behold, striae at 347°T all along it.

**Hills No. 21 rocks** — see map — in travelling down the gap as the ice from No. 20 had done, I noted 2 prominent 345°T strike outcrops of Ordovician with their ends bevelled off at 312°T suggesting that ice coming down from the gap had bevelled them off just as had happened with Hill's 2,4,5,6,7,8 rocks. Of course, it is easier to think of this happening in deglaciation phases when ice follows valleys rather than when an ice-sheet covered the whole area, as I think it did at some times. I called these rocks Hills No. 21.

**Unstriated rocks** — Fig. 8 shows a number of rocks (rings with 4 points) smoothed and/or rounded, which we suspected as due to ice action although excavation failed to detect striae.

Grey *tillite exposures* with abundant rounded facetted erratics are shown in Wiltons Ck. near the 'bluff' and also in a gully in Adair's where one very big granite erratic occurs. Many other exposures must be hidden by vegetation planted in S.C.A. enclosures (Soil Conservation Authority) when the lake was first built. Two inconspicuous cuttings in tillite are seen on the central road.

Early aerial photos of two Tertiary high level outcrops in the north show numerous white spots, each marking a gold-digger's claim. Bull-dozing or ripping has since largely obscured them. A puddling machine (PM) was once there, but I haven't seen it. The gold, of course, came from the Ordovician country nearer Heathcote via an ancestor of Mt. Ida Ck., when the whole area was covered by post-Permian hillwash of Ordovician origin.

**Ross No. 1 & 2 rocks** — two more pavements on the opposite side of Wild Duck Ck. obviously on edges of Ordovician ridges between the Permian "fingers" I mentioned in Part 1 as feeding ice from the SE to the main glacier just as Adairs trough did. Note also the tell-tale Tertiary (Tp) high-level gravels of the ancestral Wild Duck Ck. here.

Finally, attention is drawn to the rose showing how the ice direction west of north contrasts with the two previous 2 roses of Farley's and Dunn's areas. It illustrates beautifully how the bottom-ice direction is controlled by the axial direction of the tightly folded Ordovician anticlines and synclines, which would average 330°T in this area.

In conclusion, the Derrinal glacial deposits are not the result of down-faulting in a post-Permian graben, but, after 250 million years, represent a unique example of a buried Permian topography hidden under the Permian glacials, and exposed just along the edges and on the rounded inliers almost as it actually was 250 million years ago i.e. a day-trip in the Adair-Campbell-Hill-Farley area is a day-trip to see a landscape of Gondwanaland. The part overlooking the lake should be preserved as a geological monument against future development.

REFERENCES

See previous issues especially.
Thomas, D. E., (1940). Geological plan of Parish of Heathcote.
Thomas, D. E., (1941). Geological plan of Parish of Langwornor.

---

# Radiocarbon Dating of Coastal Sand at Thirteenth Beach, West of Barwon Heads, Victoria

By Edmund D. Gill* and P. F. B. Alsop**

Mantles of sand drape the shoulders of our ocean shores. To understand them is important for geology, geomorphology, archaeology, botany, engineering, conservation, and many other fields of study. Layers of sand are interleaved with soil layers, proving alternate stable and unstable conditions under natural circumstances. Radiocarbon dating allows us to put perspective into the coastal changes since the sea came to its present level about 6000 years ago. A rich history is written in those sands, and we are just beginning to spell it out.

**Over a Century of Misuse**

When the European settlers first arrived the coasts were beautiful. Most wore a mantle of green because the coastal sands were nearly all covered by vegetation — in some respects a unique vegetation. The dunes were then stable, and most had been so for something like three millenia. In the days of the Assyrians and Babylonians, and the Chow dynasty of China, the coastal dunes of Victoria were stabilizing and beginning to form a soil. Since then the soil has gradually deepened, enclosing native snails and preserving Aboriginal middens. But the activities of European settlers and the scuffing hooves of their animals destroyed the vegetation and set the sand moving. The records show that by around 1870 the problems of drifting coastal sand had become widespread. Sand drifts became a nuisance by covering farming land, fences and buildings. In places, as at Thirteenth Beach, they endangered roads.

In some places, the dunes disappeared. Thus Port Melbourne was originally called Sandridge because of its dune. But the sands were used for filling and other purposes until they had totally disappeared. A dune at Williamstown has likewise gone forever.

**Reversing History**

The present aim for coastal dunes is to reverse history by stabilizing the dunes and encouraging the growth of vegetation. Thus at Thirteenth Beach, slat fences were used to trap sand to infill sand rifts, which were then planted. Sensitive areas have been temporarily fenced off to keep people and animals out, thus permitting the natural rejuvenation of the vegetative cover. Other areas have been planted with suitable species of shrubs to inhibit sand movement and restore the natural beauty (Alsop 1975 and references).

**Wealth of History**

To stand on a dune and look along the coast is to get an impression of a simple dune history, but such simplicity is rare. Usually there is a series of layers resulting from alternations in coastal conditions. Only where a coast exists can coastal dunes form, and so with the many changes of sea level the coastal structures have changed. The sea came to its present level about 6000 years ago, since when there has been a relative stillstand, i.e. only small oscillations of sea level have occurred. Before that the present coastal area was part of a coastal plain extending far from the present shore, because the sea was lower, kilometres from the existing coastline. This occurred due to vast quantities of sea water being withdrawn to construct the extensive ice caps of the last Glacial

* 1/47 Wattle Valley Road, Canterbury, Victoria 3126
** C.R.B., McKillop St., Geelong, Victoria 3220.

Period. Before that the sea was 7 m higher and so extended a little further inland. Under the present dunes the sands of that ancient system (Last Interglacial) are commonly found. They are present between Black Rock (Fig. 1) and Barwon Heads to the east.

**Radiocarbon Date**

West of the Thirteenth Beach Life Saving Club, where the dune sands reach their highest level, a blowout in 1982 revealed a series of layers that tell the dune's history over modern millenia. At the top were loose sands with no soil at the surface and including introduced European snails such as *Theba pisana*. This is the sand that has moved since Europeans came early last century. Under that was a soil which marks the land surface when the settlers arrived. Under that was another layer of blown sand below which was a dark grey soil about half a metre thick. The erosion had almost completed the destruction of an Aboriginal midden in the soil, but a couple of shells of *Subninella undulata* (collected from a rocky shore platform) still remained in place and these were rescued for a radiocarbon date. The site is about 14 m above A.H.D. The conventional radiocarbon date for the midden shells is 3690 ± 230 years B.P. (SUA-1613). E.D.G. has dated the waters of Bass Strait as being about 450 years (the same as the East Australian current), so subtracting this from the age of the shells grown in that water, a date of about 3240 years is obtained. Dates (with the same deduction) for coastal dune soils in S.W. Victoria are 2800 years for Tower Hill Beach, 2630 years for Dura Bay west of Port Fairy, and 2870 years for near Cape Reamur.

**Older Sand Deposits**

Alsop (1973, p. 140, 1981) reports a 2m clifflet in older consolidated sands,

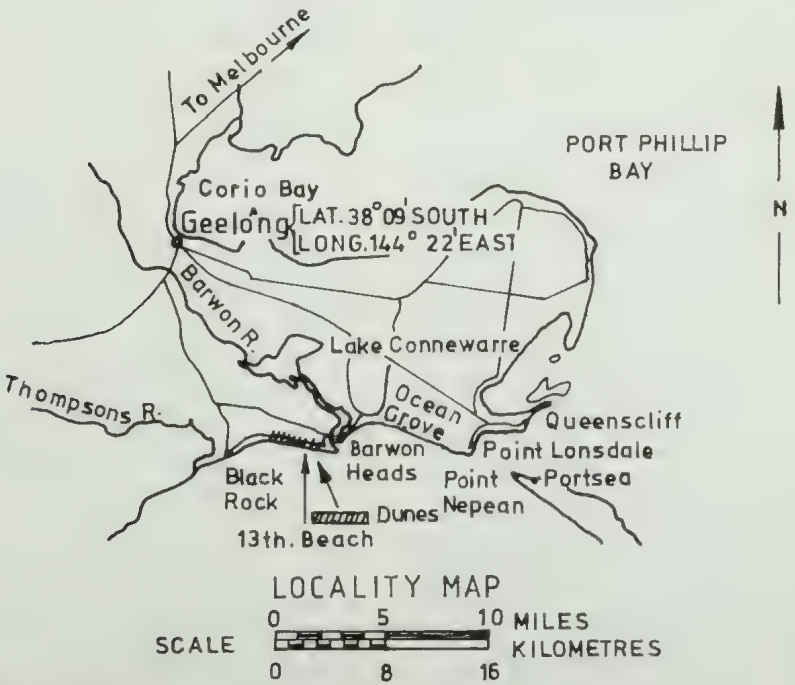



Fig. 1. Map of locality.

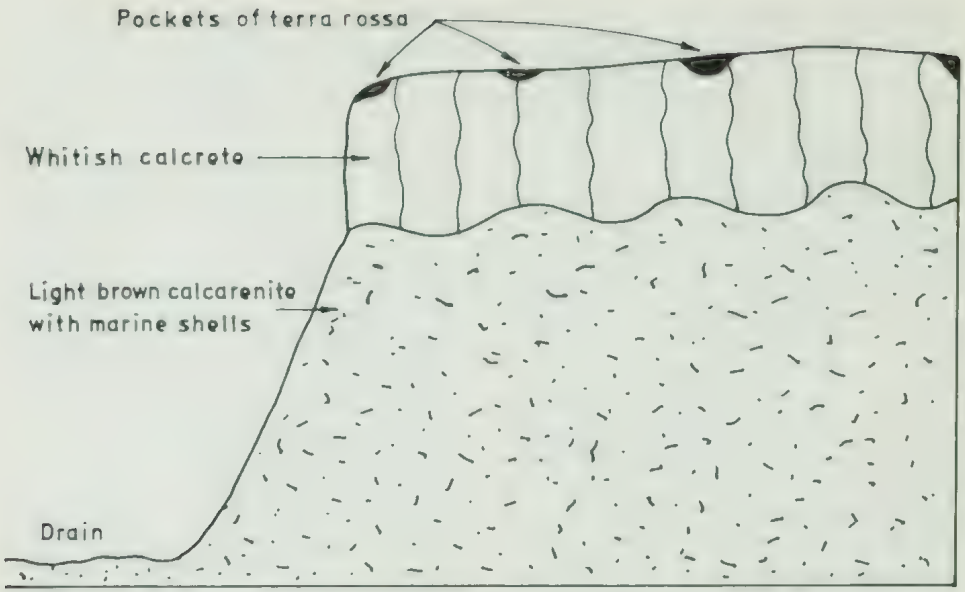



Fig. 2. Section of drain at Black Rock west of Barwon Heads showing calcrete (B horizon of terrarossa) over marine Port Fairy calcarenite

but it is now covered by modern sand. The sands consolidate because of their high percentage of carbonate, viz. 36% (Alsop 1973) to 50% (Dr R. H. Williamson). On the Barwon Heads side of the Black Rock basalt outcrop there is a formation of Last Interglacial sand with a still higher percentage of carbonate. It is a shallow marine deposit with *Subninella* and *Haliotis*, rock molluscs that no doubt grew on the basalt alongside. This formation is of uncemented lime sand (calcarenite) covered by half a metre of calcrete, which is the subsoil of a terra rossa. Patches of the latter occur here and there in the surface of the calcrete. This formation has been studied in detail in S.W. Victoria, and is called the Port Fairy Calcarenite, dated about 125,000 years old. The calcrete was deposited during a dry period about 21,000 to 8,000 years B.P. (Gill 1975). At Black Rock two drains normal to the shore make it possible to study the formation in some detail (Fig. 2).

Daintree (1862) reported an emerged shell bed with oysters near Queenscliff (Gill 1948). This also is Last Interglacial in age. There were caves in it from which guano was collected. The rocky ridge on which Queenscliff stands is a Last Interglacial dune (Dennington Aeolianite). A fossil sea lion was described from there (McCoy 1877, Gill 1968) that indicates the climate was warmer than now. The Point Lonsdale lighthouse also stands on Dennington Aeolianite. The above two Last Interglacial formations also occur on the Point Nepean Peninsula on the other side of Port Phillip Bay.

Dr G. E. Williams had radiocarbon datings done on marine shells from the coast at Ocean Grove (Gill 1973), viz. 335, 470, 5780 and 14,900 years B.P. As the dates were on marine shells, 450 years has to be subtracted from them, which means that the first two are modern. The 5330 year date is for a soil at the base of the sand cover emplaced since the sea came to its present level about 6,000 years ago. In the same date list, Dr E. C. F. Bird records a date of 5,350 years for organic matter from a

black soil in the dunes at Diamond Bay near Portsea.

Dr Williams' date of 14,900 years is on the coastal mollusc *Subninella*, but at that time the coast was kilometres seaward of its present position. It is probably a last Interglacial shell with a little contamination. As Last Interglacial shells have no radiocarbon left, a minute amount of contamination is all that is necessary to give them a radiocarbon age. This could be tested by a uranium/thorium dating.

**Conclusion**

The coast from Black Rock (Fig. 1) to Port Phillip is complex and as yet we know little about it. The radiocarbon date and other information provided herein is a small contribution towards elucidating its history.

REFERENCES


Alsop, P.F.B., (1973). The stabilization of coastal sand dunes. *Ist. Aust. Conf. Coastal & Ocean Engin. Preprints* pp. 140-147.

Alsop, P.F.B., (1981). Fifteen years' measurements on stabilizing a coastal dune. Roy. Aust. Inst. Parks & Recreation *Papers presented at National Workshops on Coastal Management*, Queenscliff 8-10 Sept., 1981, pp. 13-1 to 13-19.

Daintree, R., (1862). Report on the geology of Bellarine and Paywit, with special reference to the probable existence of workable coal seams in those parishes. Geol. Surv. Rep., *Votes & Proc. Legislative Council Victoria.*

Gill, E.D., (1948). Geology of the Point Lonsdale-Queenscliff area, Victoria. *Victorian Nat. 65:* 2-10.

Gill, E.D., (1968). Fossil sea lion as a palaeoclimatologic indicator. *Palaeogeogr., Palaeoclimat., Palaeoecol.* 5: 235-239.

Gill, E.D., (1973). Second list of radiocarbon dates on samples from Victoria, Australia. *Proc. R. Soc. Vict.* 86: 133-136.

Gill, E.D., (1975). Calcrete hardpans and rhizomorphs in Western Victoria, Australia. *Pacific Geol.* 9: 1-16.


---

## *Naturalist Review*

### "Antarctic Wildlife"


by Eric Hosking and Bryan Sage
Croom Helm, London and Canberra
ISBN 0-7099-1215-3 Rrp $29.95


With the 1959 Antarctic Treaty soon to be renegotiated there has been much recent interest in the Frozen Continent — and not only by scientists. Antarctic research was one of the few areas to receive a real increase in the science vote of the 1982 Federal budget. Although the 1959 Treaty did not grant territorial rights or recognize claims, it nevertheless agreed to Australia being responsible for administering 42% of the continent's area. Clearly Australia should at least be seen to be intensively researching Antarctica's resources if we are to succeed in maintaining our "administrative responsibilities" in the future.

Antarctica has long been a place where international relations are not as chilly as the physical environment. The free exchange of information and free access to bases reflects a goodwill which will be under future strain as pressures steadily increase to share the responsibilities for and exploitation of the continent's vast resources.

And what resources! As a former part of Gondwanaland, Antarctica is "thought to be rich in oil, natural gas, ores, uranium, gold, diamonds and platinum" (*'The Age'*, 24/xi/82, p.8). The nutrient rich waters also support vast quantities of harvestable protein in the form of small crustaceans (krill). Currently Japanese and Soviet trawlers take about 200,000 tonnes annually — but an increasingly hungry World is looking at a potential take of 150 million tonnes! The possible effects of such cropping on so delicate an ecosystem are alarming. Interestingly, Australia's Antarctic Research Policy Advisory Committee has recently called for proposals for research to be conducted into, among other things, "the environmental impact of possible mineral and living resource exploitation activities". This would form part of Australia's contribution to the

international BIOMASS program to be conducted in Prydz Bay later this year.

"Antarctic Wildlife" is mainly a medium for Eric Hosking's photographs of Antarctica and its life. On reading the dust cover, that is really all I expected the book to be — a series of very fine photographs with a little bit of not very illuminating description (as in many Australian wildlife photography books). It is much more than this thanks to an expert text by Sage. An introductory chapter briefly outlines the history of exploration of Antarctica. Photographs of the huts of Shackleton and Scott provide vivid support to the well-written and informative story. Nothing is overdone, but the reader's desire to find out more on this topic cannot help to be kindled. The feeling of dread, isolation, sheer cold and savagery of the environment experienced by the early explorers is made very clear.

Then follow chapters on "The Antarctic and Its Ecology" (containing comparisons between the two polar regions and information on the continent itself, the surrounding sea and then the Subantarctic), "Penguins", "Albatrosses", "Other Birds", and finally, one on hints on wildlife photography in the Antarctic.

The book is packed with interesting observations. Did you know, for instance, that skuas have been seen taking milk from lactating Southern Elephant Seals? That Sheathbills are so tame and inquisitive that on seeing men approach, the birds race to meet the arrivals and stay around even if some of their fellows are knocked aside? That the Crabeater Seal is the most common pinniped in the world and that most adults bear scars of prior attacks by predatory Leopard Seals and Killer Whales? That the World's lowest temperature (-88.3°C) was recorded in Antarctica? That the first man to have probably sighted the continent was a Polynesian in a canoe (that's right) in about 650 A.D.? . . . And so on.

Criticisms are few and minor. It is annoying to read of "birds and animals" (if birds are not animals, what are they — trees?). Sage suggests that before man, there were no above ground predators of penguins (no skuas?). Some of the excellent photographs are spoiled by the book's centre binding. Several localities do not appear on the map.

Both text and photographs stress the ecosystem's fragility. One problem man makes is his litter and junk in a place where natural decomposition is practically non existent. Another is the danger of overharvesting — whether it be for seals or krill.

A good book and good value.

**R. Wallis**

---

## Field Naturalists Club of Victoria

### Reports of recent activities

**General Meeting**
**Monday 10 January**

(Continued from page 43 last issue)

**Conservation.** There was more about our submssion to the LCC on extension of the Alpine national park, and concern that anti-park bodies are numerous and powerful. The President read the letter sent to 15 ministers protesting against the damming of the Franklin River. One of our members at the Franklin is among the protesters who have been jailed for trespassing.

**Exhibits.** Under a microscope was a small anemone *Corynactis australis* that had knobs on the end of its tentacles; it was found at Black Rock. There was a display of plants from Hillary Weatherhead's triangle survey, and some of the marine creatures that can be seen at Honeysuckle Point.

**Holiday at Falls Creek**
**Sat-Friday 15-22 January**

Our 34 members stayed at Falls Creek Motel and all will remember the superbly delicious dinners painfully prolonged. Also memorable was the barbecue at Wallace's Hut where our lunch arrived by pack-horse. And the weather was sunny and clear the whole time.

The Bogong high country was very disappointing for botanists this season. Instead of the expected spread of flowers there were merely sprinkles; expanses of *Celmisia* leaves carried only one or two daisies and no dead-heads — they had not flowered. We had not realised that a drought, even this very severe one, would influence the alps, but local opinion explained that the snow had not been deep enough nor remained long enough. However, there were impressive patches of Carpet Heath *Pentachondra pumilis* covered in tiny star-like flowers with scatterings of the larger scarlet berries.

Our bird enthusiasts fared better. They reported more birds than expected — over 30 species in the high country and some were nesting.

**General Excursion to Western Port**
**Sunday 6 February**

Led by Dr Brian Smith a full bus went to the Shoreham camping ground. Members walked to the beach and on to the rock platform of Honeysuckle Point. The two forms of basalt were evident even to the layman's eye — hard young rock towards the sea and soft older material in the lower middle parts but carrying boulders of the younger rock.

The tide was going out and members examined the numerous rock pools. There were masses of various seaweeds including the small form of Neptune's Necklace *Hormisira* sp endemic to Western Port. The most spectacular of the many animals were brittle stars, feather stars, and the pink-red nudibranch Magic Carpet *Ceratosoma brevicaudata*. There were sea urchins, sea elephants, sea stars, sponges, abalone and various worms including a Peanut Worm *Phascolosoma noduliferum*.

At about 1.30 pm a heavy fog came in from the SE and members still on the reef could not see the beach. Such fogs occur frequently on the NSW coast in February but are not common as far south as Western Port.

Because of the fog, members with the leader discussed their findings where they were and unloaded most of them in a pool before proceeding to the beach — directed by the sounds of traffic. Consequently, those who had left the rocks earlier missed out on most of the discussions.

After a late lunch we went to Cape Schanck with the idea of comparing the animal life of such a high energy area with that of sheltered Honeysuckle Pt. But the fog blotted out everything and only a few continued right down the new wooden staircase that is being built.

**General Meeting**
**Monday 14 February**

**Speaker** for the evening was Mr Peter Brown on "The role of Zoos". Zoos have a history that goes back some 4000 years as wild animals were kept in captivity by the pharaohs of ancient Egypt; China also had zoos. The modern zoo was developed last century when animals were displayed in cages, but vast improvements have been made this century. Up to about ten years ago Melbourne's caged tigers had never bred but, since being placed in a more congenial environment, they have become very fecund and are now on the pill!

Mr Brown stated five major purposes for zoos — passive recreation, nature appreciation, education, research and conservation. His main interest is conservation. Endangered species can be saved if bred at zoos and Mr Brown gave several examples. The Laysan Teal had been reduced to one female and a clutch of eggs; fortunately there were no genetic problems and the species has survived and increased. Other examples included Chinese Deer, Wine Goose and European Bison, all reduced to a few dozen individuals but now in thousands due to the efforts of zoos.

(Continued inside back cover)

# FIELD NATURALISTS CLUB OF VICTORIA

**Report by Executive Council**

In accordance with Section 270 of the Companies (Victoria) Code 1981, the members of the Executive Council submit herewith balance sheet as at 31 December 1982, and statement of income and expenditure for the year ended on that date, and report as follows:—

1. The names of the members of the Executive Council in office at the date of this report are as follows:—

   Miss W. Clark
   Dr B. J. Smith
   Mrs S. Houghton
   Mr D. Dunn
   Miss M. Allender
   Mr P. Carwardine
   Mr J. Grusovin
   Miss J. Scott
   Mrs H. Weatherhead

2. The principal activities and objects of the Club are to stimulate interest in natural history and to preserve and protect Australian Fauna and Flora. No significant change in the nature of those activities occurred during that period.

3. The net surplus of the Club for the year ended 31 December 1982 was $136 in the General Account. In addition surpluses were earned in the following Funds:—

   Building Fund $924, Publications Fund $6,378.
   Excursion Fund $2,953 and Special Funds $220.

4. The following transfers to and from Funds have been made during the year ended 31 December 1982:—

   From Club Improvement Account to General Account Surplus $549.
   From Income & Expenditure Account to Club Improvement Account $1,121.

5. The Club has issued no shares or debentures during the year.

6. Before the income and expenditure accounts and balance sheet were made out, the Executive Council took reasonable steps to ascertain what action had been taken in relation to the writing off of bad debts and the making of provision for doubtful debts and to cause all known bad debts to be written off and adequate provision to be made for doubtful debts.

7. At the date of this report the Executive Council is not aware of any circumstances which would render the amount written off for bad debts or the amount of the provision for doubtful debts inadequate to any substantial extent.

8. Before the income and expenditure account and balance sheet were made out the Executive Council took reasonable steps to ascertain whether any current assets (other than those current assets referred to in paragraph [6]) were unlikely to realize in the ordinary course of business their value as shown in the accounting records of the Club and, if so, to cause:—
   (a) Those assets to be written down to an amount which they might be expected to realize; or
   (b) Adequate provision to be made for the difference between the amount of the value as so shown and the amount that they might be expected to realize.

9. At the date of this report the Executive Council is not aware of any circumstances which would render the value attributed to current assets in the accounts misleading.

10. At the date of this report there exists no charge on the assets of the Club which has arisen since the end of the financial year and secures the liabilities of any other person and no contingent liability has arisen since the end of the financial year.

11. No contingent or other liability has become enforceable or is likely to become enforceable within the period of twelve months after the end of the financial year which, in the opinion of the Executive Council, will or may affect the ability of the Club to meet its obligations when they fall due.

12. At the date of this report the Executive Council is not aware of any circumstances not otherwise dealt with in the report or accounts which would render any amount stated in the accounts misleading.

13. The Club is prohibited from paying a dividend by its Memorandum and Articles of Association; consequently no dividend is recommended and no dividends have been paid or declared.

14. The Executive Council is of the opinion that the results of the Club's operations during the financial year were not substantially affected by any item, transaction or event of a material and unusual nature.

15. In the interval between the end of the financial year and the date of this report, no item, transaction or event of a material and unusual nature has arisen which is likely, in the opinion of the Executive Council, to affect substantially the results of the Club's operations for the next succeeding financial year.

16. Since the end of the previous financial year no member of the Executive Council has received or become entitled to receive any benefit by reason of a contract made by the Club with him or with a firm of which he is a member or with a company in which he has substantial financial interest.

This Report is made in accordance with a resolution of the Executive Council dated 31st day of March 1983.

W. Clark President
D. Dunn Treasurer

# FIELD NATURALISTS CLUB OF VICTORIA
# BUILDING FUND

| | | |
|---|---|---|
| Amount of Fund at 31 December 1981 | | $6,576 |
| Interest on Investments and Bank Account | | 924 |
| Amount of Fund at 31 December 1981 | | $7,500 |

# PUBLICATIONS FUND

| | | |
|---|---|---|
| Amount of Fund at 31 December 1981 | | $36,620 |
| Interest on Investments and Bank Account | | 5,893 |
| Surplus (Loss) for the year from— | | |
| Ferns of Victoria and Tasmania | $478 | |
| Wild Flowers of Wilson's Promontory National Park | 7 | 485 |
| Amount of Fund at 31 December 1982 | | $42,998 |

# CLUB IMPROVEMENT ACCOUNT

| | | |
|---|---|---|
| Amount of Account at 31 December 1981 | | $6,991 |
| Transfer from W. C. Woollard Fund (Microscopes purchased) | | 200 |
| Book Sales Account Profit | | 1,121 |
| Donation & Library Sale | | 67 |
| | | $8,379 |
| *Less* — Purchase of Library Books & Equipment transferred to Surplus Account | | 549 |
| Amount of Account at 31 December 1982 | | $7,830 |

# EXCURSION FUND

| | | |
|---|---|---|
| Amount of Fund at 31 December 1981 | | $4,827 |
| Interest received on Investments & Bank Account | $1,640 | |
| Donation | 20 | |
| Surplus on Tours | 1,293 | 2,953 |
| Amount of Fund at 31 December 1982 | | $7,780 |

**Field Naturalists Club of Victoria**
**Statement by the Members of the Executive Council**

In the opinion of the members of the Executive Council of the FIELD NATURALISTS CLUB OF VICTORIA, the accompanying Balance Sheet is drawn up so as to give a true and fair view of the state of affairs of the Club as at 31 December 1982, and the accompanying Statement of Income and Expenditure is drawn up so as to give a true and fair view of the financial results of the Club for the year ended 31 December 1982. There are reasonable grounds to believe that the Club will be able to pay its debts as and when they fall due. Signed in accordance with a resolution of the Executive Council on 31st March 1983.

Wendy Clark President
David Dunn Treasurer

**Auditors' Report to the Members of**
**Field Naturalists Club of Victoria**

In our opinion—

(a) The attached accounts, being the Balance Sheet, Statement of Income and Expenditure and Notes to Accounts, which have been prepared under the historical cost convention as stated in Note 4, together with the Statement by Members of the Executive Council, are properly drawn up in accordance with the provisions of the Companies (Victoria) Code 1981, and so as to give a true and fair view of—
  (i) the state of affairs of the company at 31 December 1982 and the results of the company for the year ended on that date;
  and
  (ii) the other matters required by Section 269 of that Code to be dealt with in the accounts.

(b) The accounting records and other records and registers required by that Code to be kept by the company have been properly kept in accordance with the provisions of that Code.

DANBY BLAND PROVAN & CO.
Chartered Accountants
R. M. Bland
Partner

Melbourne
1 April 1983

# FIELD NATURALISTS CLUB OF VICTORIA
# BALANCE SHEET AT 31 DECEMBER, 1982

## LIABILITIES

| 1981 | | | | |
|---|---|---|---|---|
| | **Current Liabilities** | | | |
| $1,369 | Subscriptions paid in advance | $2,391 | | |
| 2,216 | Sundry Creditors | 2,558 | | |
| 120 | M. A. Ingram Trust Grant in hand | 62 | | |
| 4,000 | Treasury Grants in hand (Note 3) | 5,500 | | |
| $7,705 | | | $10,511 | |
| | **Special Funds & Accounts** | | | |
| $6,576 | Building Fund | $7,500 | | |
| 36,620 | Publication Fund | 42,999 | | |
| 4,827 | Excursion Fund | 7,780 | | |
| 6,000 | Marie Allender Excursion Fund | 6,000 | | |
| 100 | Library Fund | 100 | | |
| 6,991 | Club Improvement Account | 7,830 | | |
| 5,217 | Estate M. Wright Legacy | 5,217 | | |
| 1,466 | Estate C. M. Walker Legacy | 1,466 | | |
| 20 | Estate R. S. Chisholm | 20 | | |
| 200 | Estate I. F. Knox | 200 | | |
| 200 | Estate Ivy Dixon | 200 | | |
| 204 | Estate I. Hanks | 204 | | |
| 730 | Wilfred C. Woollard Fund | 597 | | |
| 638 | D. E. McInnes Fund | 673 | | |
| 324 | V. H. & B. E. Miller Fund | 352 | | |
| 90 | N. A. Wakefield Memorial Fund | 90 | | |
| 300 | P. F. Morris Gift Account | 300 | | |
| 250 | Cedric Ralph Gift Account | 250 | | |
| 54 | Kinglake Project Fund | 54 | | |
| 1,644 | Natural History Medallion Fund | 1,934 | | |
| 520 | Life Membership Fund | 520 | | |
| 311 | Microscope Project Account | 311 | | |
| $73,282 | | | $84,597 | |

## ASSETS

| 1981 | | | | |
|---|---|---|---|---|
| | **Current Assets** | | | |
| $2,855 | Cash at Bank | $3,760 | | |
| 10,000 | Commonwealth Bonds at cost | 10,000 | | |
| 406 | Sundry Debtors | 8 | | |
| | Stocks on Hand at cost — | | | |
| 3 | Badges | — | | |
| 123 | Microscope Project | 123 | | |
| 1,330 | Books for Sale | 1,204 | | |
| 55 | Tee Shirts | 3 | | |
| 1,624 | Victorian Naturalist Subject Index | 1,568 | | |
| $16,396 | | | $16,666 | |
| | **Fixed Assets at cost —** | | | |
| $8,442 | Library Furniture & Equipment | $8,990 | | |
| | Land — | | | |
| 141 | Cosstick Reserve, Maryborough | 141 | | |
| — | Harold C. Frahm, Kinglake | — | | |
| $8,583 | | | $9,131 | |
| | **Investment of Funds** at cost | | | |
| $100 | Australian Government Bonds | — | | |
| 8,200 | Australian Gov't Savings Bonds | $8,300 | | |
| 7,500 | Esanda Ltd Debentures | 7,500 | | |
| | National Mutual Permanent | | | |
| 3,982 | Building Society — Deposit | 7,582 | | |
| — | Statewide Building Society — Deposit | 132 | | |
| $19,782 | | | $23,514 | |
| | **Building Fund** | | | |
| $3,000 | Aust Gov't Savings Bonds at cost | $2,700 | | |
| 3,400 | Esanda Ltd — Debentures at cost | 4,400 | | |
| 176 | Cash at Bank | 400 | | |
| $6,576 | | | $7,500 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Surplus Account** | | | | **Publications Fund** | | |
| $11,133 | Balance at 1/1/1982 | $11,797 | | $31,200 | Aust Gov't Savings Bonds at cost | $42,780 | |
| | Transfer from Club Improvement | | | | National Mutual Permanent | | |
| 661 | Fund | 549 | | 3,249 | Building Society — Deposit | — | |
| 3 | Surplus for year | 136 | | 424 | Book Stocks at cost | 216 | |
| | | | | 762 | Sundry Debtors | — | |
| $11,797 | | | $12,482 | 1,113 | Cash at Bank | 3 | |
| | | | | (128) | **Less** Sundry Creditors | — | |
| | | | | $36,620 | | | $42,999 |
| | | | | | **Excursion Fund** | | |
| | | | | $1,000 | Aust Gov't Savings Bonds at cost | $1,000 | |
| | | | | | National Mutual Permanent | | |
| | | | | 2,184 | Building Society — Deposit | 6,252 | |
| | | | | 7,343 | Cash at Bank | 9,558 | |
| | | | | (5,700) | Less Sundry Creditors | (9,030) | |
| | | | | $4,827 | | | $7,780 |
| $92,784 | | | $107,590 | $92,784 | | | $107,590 |

1. Auditors' Remuneration of $150 relates to auditing services only. No other benefits were received by the Auditors in respect of their services to the Club.
2. No Emoluments were paid by the Club to any member of the Executive Council.
3. State Treasury Grants for 1979/80, 1980/81, 1981/82 and 1982/83 have been received, but grants totalling $5,500 had not been applied against expenditure at 31/12/1982.
4. Basis of Accounting. The accounts have been prepared under the historical cost convention and have not been adjusted to take into account the current cost of specific assets.

# FIELD NATURALISTS CLUB OF VICTORIA
## GENERAL ACCOUNT
## STATEMENT OF INCOME & EXPENDITURE FOR YEAR ENDED 31 DECEMBER, 1982

### INCOME

| 1981 | | | | 1981 |
|---|---|---|---|---|
| | Subscriptions Received — | | | |
| $290 | Arrears | $184 | | $11,549 |
| 11,685 | Current | 13,930 | | 599 |
| 324 | Supporting | 384 | | 1,357 |
| $12,299 | | | $14,498 | — |
| $438 | Sales of "Victorian Naturalist" | | $842 | $13,505 |
| | Interest Received — | | | |
| $5 | Library Fund | $13 | | $(74) |
| 122 | Bank Account | 80 | | (3,500) |
| 564 | Commonwealth Bonds | 1,654 | | $9,931 |
| 421 | Bonds — M. Wright Legacy | 860 | | |
| 81 | Bonds — C. M. Walker Legacy | 165 | | |
| 795 | National Mutual Deposit | 1,071 | | $368 |
| 67 | Life Membership Fund | 67 | | 1,100 |
| 186 | Natural History Medallion Fund | 205 | | 1,126 |
| | | | | 893 |
| $2,241 | | | $4,115 | 40 |
| $(6) | Profit — Tee Shirt Sales | | 7 | |
| 204 | Sundry Income | | — | 179 |
| 2,248 | Profit on Book Sales | | 1,121 | 140 |
| | | | | 201 |
| $2,446 | | | | 114 |
| | | | | 882 |
| | | | | 150 |
| | | | | $5,193 |
| | | | | $1 |
| | | | | 48 |
| | | | | 2,248 |
| | | | | 3 |
| $17,424 | | | $20,583 | $17,424 |

### EXPENDITURE

| | | |
|---|---|---|
| Victorian Naturalist | | |
| Printing | $12,187 | |
| Illustrating | 1,029 | |
| Despatching | 1,775 | |
| Editorial | 120 | |
| | $15,111 | |
| Less — Grants | | |
| Ingram Trust | | |
| Treasury (Note 3) | | |
| | | $15,111 |
| Working Expenses — | | |
| Postage & Telephone | $337 | |
| Printing & Stationery | 355 | |
| Bookkeeping & Typing | 1,063 | |
| Rent — Herbarium & Museum | 750 | |
| Rent for storage | 20 | |
| Affiliation Fees, Subscriptions & Donations | 262 | |
| Auditors' Remuneration (Note 1) | 150 | |
| Insurance | 186 | |
| General Expenses | 219 | |
| Natural History Medallion Expenses | 393 | |
| Kinglake Expenses — Rates | 165 | |
| | | $3,900 |
| Mammal Survey Group Trailer | | 311 |
| Badges — Loss | | |
| Subject Index — Loss | | 4 |
| Club Improvement Account — Transfer of Profit on Book Sales | | 1,121 |
| Surplus for year | | 136 |
| | | $20,583 |

(continued from page 81)

Wild animals are part of the world heritage and zoos can be caretakers by breeding animals in captivity instead of taking more from the wild. The final objective is to re-introduce endangered species to their native habitats, but that often presents problems as many habitats are being destroyed.

**Conservation.** Replies had been received from some of the Ministers to whom we had sent letters protesting against damming the Franklin. There was support for the CCV draft of proposed legislation to protect habitats of protected species.

**Exhibits.** There was a fine display of green seaweeds from Black Rock — four species of *Calerpa* and two *Codium,* and preserved specimens of a sea lily, peanut worm, 2 cm cling fish, and a colour slide was projected of the Magic Carpet nudibranch. Two active green tree frogs from NSW, each about 5 cm (2″) were displayed in a chill-thwarting glass case.

---

## THANKS

Thank you to all members who included donations with their subscriptions.

Council also thanks members who filled in the membership questionnaire. Our chief purpose was to find people with specific skills who might be willing to become Office Bearers or Council Members. If we do not contact you, please do not think that we do not appreciate your co-operation. The variety of your replies has given us ideas for a range of Club activities and encouragement to develop them.

Sheila Houghton
Hon. Secretary

# *Field Naturalists Club of Victoria*

Established 1880

**OBJECTS:** To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

*Patron:*
His Excellency Rear Admiral Sir Brian S. Murray, KCMG, AO.

**Key Office-Bearers 1982-1983**

*President:*
Miss WENDY CLARK, 27 Rangeview Grove, North Balwyn, 3104 (859 8091 A.H.)
*Vice-President:* Dr. B. Smith, C/- The National Museum, Russell Street, Melbourne
*Secretary:* Mrs. Sheila Houghton, 30 Golf Links Crescent, Dingley, 3172 (551 2708)
*Correspondence to:* FNCV, National Herbarium, The Domain, South Yarra, 3141
*Treasurer:* Mr. D. DUNN, 3 Allfrey Street, East Brighton, 3187 (578 5753)
*Subscription-Secretary:* Miss H. MALCOLM C. - National Herbarium, The Domain, South Yarra, 3141
*Editor:* Mr. R. WALLIS, Victoria College — Rusden Campus, 662 Blackburn Road, North Clayton, 3168 (544 8544)
*Librarian:*
*Excursion Secretary:* Miss M. ALLENDER, 19 Hawthorn Avenue, Caulfield, 3161 (527 2749)
*Book Sales Officer:* Mr. D. E. McINNES, 129 Waverley Road, East Malvern, 3145 (211 2427)

**Group Secretaries**

*Botany:* Mr. MICHAEL McBAIN, 19 Foster Street, St. Kilda, 3182 (534 2293)
*Day Group:* C/- National Herbarium, The Domain, South Yarra, 3141
*Geology:* Mr. T. SAULT, C/- National Herbarium, The Domain, South Yarra, 3141
*Mammal Survey:* Mr. A. FAITHFUL, 67 Athelstan Road, Camberwell, 3124 (29 5108 A.H.)
*Microscopical:* Mr. M. H. MEYER, 36 Milroy Street, East Brighton (596 3268)
*FNCV Kinglake Nature Reserve:* McMahons Road, Kinglake
*Booking and keys:* Mr. I. F. MORRISON, 788 Elgar Road, Doncaster (848 1194)

**MEMBERSHIP**

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

**Subscription rates for 1982**

| | |
|---|---|
| Metropolitan | $15.00 |
| Joint Metropolitan | $18.00 |
| Country Members and Retired Persons | $12.00 |
| Joint Country and Joint Retired | $15.00 |
| Junior | $3.00 |
| Subscription to Victorian Naturalist | $13.00 |
| Overseas Subscription to Victorian Naturalist | $15.00 |
| Individual Journals | $2.20 |

All subscriptions should be made payable to the Field Naturalist Club of Victoria and posted to the Subscription Secretary

Jenkin Buxton Printers Pty. Ltd. 113 ABBOTSFORD ST WEST MELBOURNE 328 4774 329 7959

# The Victorian Naturalist

Vol. 100, No. 3
May/June
1983

Published by the FIELD NATURALISTS CLUB OF VICTORIA
in which is incorporated the Microscopical Society of Victoria

Registered by Australia Post. Publication No. V.B.P. 1268

$2.20

## GENERAL MEETINGS

**Monday, 6th June, 8.00 p.m.**

Dr F. Newman. Current trends in forest entomology.

**Monday, 11th July, 8.00 p.m.**

Mr Eric Muir. The Little Desert.

Honorary membership will be awarded to Mr Eric Muir.

**Monday, 8th August, 8.00 p.m.**

Mr Cliff Beauglehole. Distribution and conservation of vascular plants in the Melbourne study area.

**New Members — May/June General Meetings.**

*Metropolitan*

Richard Evans, 27 Durham Street, Heidelberg (Wildlife)
Garrique Pergel, 23 Colby Drive, Belgrave Heights

*Joint*

I. I. Burns, 2 Lansell Court, Toorak

## FNCV EXCURSIONS

**Sunday, 3rd July.** National Museum of Victoria. Meet at 1.30 p.m. at Russell Street entrance.

**Sunday, 7th August.** Queenscliff: historic and general. The coach will leave Batman Avenue at 9.30 a.m. Fare $9.00. Bring a picnic lunch.

**Sunday, 4th September.** Cranbourne. The coach will leave Batman Avenue at 9.30 a.m. Fare $7.00. Bring a picnic lunch.

**Friday evening, 2nd — Sunday, 4th September.** Campout at Cathedral Range. Led by Mr John Milligan and accompanied by Dr J. H. Willis. **See details below.**

**Friday, 16th — Friday, 30th September.** Sydney, Lord Howe Island, Norfolk Island, Sydney. Members travel by plane to Lord Howe Island leaving Sydney Friday, 16th September, staying there a week; then flying to Norfolk Island for the second week, returning to Sydney on Friday, 30th September. Accommodation will be full board on Lord Howe Island and room only on Norfolk Island. Cost $1125.00 (subject to alteration if prices change). A deposit of $100 is required and the balance by 29th July. Please check if there are vacancies before sending money. **Passport or document of identity is required on Norfolk Island.** Documents of identity are applied for on passport application forms, cost $5.00 and last 5 years. The Excursion Secretary will make a group booking for accommodation in Sydney for the night before and the night after the excursion if members desire it.

**Saturday, 8th — Sunday, 9th October.** Combined V.F.N.C.A. weekend. This excursion will be based on the Bellarine Peninsula and will be hosted by the Geelong F.N.C. There will be excursions on Saturday and Sunday, and a meeting on Saturday night.

**12th — 19th January.** King Island. See details next Naturalist.

**2nd — 4th September. Weekend campout at Cathedral Range State Park.** The walks held on this weekend will range from an easy amble to a rough and rugged scramble. The easier walks will be held on Saturday and the harder one on Sunday. We will be pitching tents at Ned's Gully campsite, which is reached from Melbourne by taking the Maroondah Highway to Cathedral lane (9.7km on right hand side after passing through Buxton), continuing along Cathedral Lane for a further 3.8 km and turning right at Little River Road which is followed for 2.7 km. The campsite is well signposted. Car parking is to the left and campsites to the right over the footbridge. We intend travelling out on Friday night, but if anybody intends arriving on Saturday or Sunday morning please arrive by 9.30 a.m.

**Saturday morning.** MacLennan's Gully. An easy walk passing through magnificent stands of manna gum, open stringybark forest and lovely ferny places.

**Saturday afternoon.** Beautiful pastoral views from a narrow sandstone ridge are the rewards of a steep ascent of Knobby Spur. **Sunday.** A rough and risky scramble. We will visit some of the hidden treasures of the Cathedral Range. Definitely for the footsure but do not be deterred from attending if you feel you cannot handle this walk — there are many other fascinating places you may wish to visit. Any minors attending should have written permission from their parents.

## GROUP MEETINGS

FNCV members are invited to attend any Group meeting.

**Day Group — Third Thursday.**

Thursday, 16th June. Melbourne Concert Hall. Meet in the foyer at 10.30 for 10.45 a.m. tour. Charge $1.50. Then meet outside the National Gallery at 1.15 for 1.30 tour. Charge 80c. Leader: R. Graham (469 2509).

Thursday, 21st July. To be announced. For details contact E. Gillespie (578 1879).

**At the National Herbarium, Birdwood Avenue, South Yarra, at 8.00 p.m.**

**First Tuesday — Mammal Survey Group.**

Tuesday, 5th July. Graeme Suckling speaking on Fauna Conservation in the Forest — some current research and ideas.

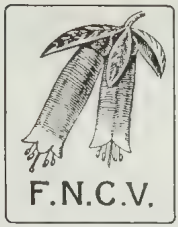
**Third Wednesday — Microscopy Group.**

**Second Thursday — Botany Group.**

Thursday, 14th July. Nancy Maddocks. Arnhem Land safari.

Thursday, 11th August. Trevor Blake.

(Continued on page 133)




# The Victorian Naturalist

Volume 100, Number 3

May/June, 1983

ISSN 0042-5184





*Cover illustration* — Leadbeater's Possum *(Gymnobelideus leadbeateri)* — Victoria's faunal emblem. See article page 92.

# Leadbeater's Possum — Survey by Stag-watching

By J. H. Seebeck,* G. C. Suckling† and M. A. MacFarlane†

**Introduction**

Since the rediscovery in 1961 of Leadbeater's Possum, *Gymnobelideus leadbeateri* (Wilkinson 1961), most reported sightings have been made whilst the observer was using a 6 or 12 volt portable spotlight. Although this technique sometimes reveals the presence of the possums, it is frequently unsuccessful, and it is also not possible to gain any estimate of population size (Smith 1982). During field studies on *Gymnobelideus*, Smith (1980) developed the technique of nest-tree observation, in which single observers were stationed at previously selected potential nest trees just before dusk, and were then able to observe and count the possums which emerged from nest hollows. Using this simple technique (which is called 'stag-watching') with 50-180 observers, Smith was able to simultaneously count virtually all the animals in his study area on four occasions.

The technique requires a large number of observers but they need not be very experienced possum-watchers. Leadbeater's Possum is readily distinguished from most other species of possum by its appearance. One exception is the Sugar Glider *Petaurus breviceps*, which it closely resembles. However, behaviour of the two species is quite different and this can be used as a distinguishing factor. Leadbeaters Possum usually emerges quickly from its nest entrance and then leaps into adjacent understorey vegetation, whilst the Sugar Glider, after emergence, climbs rapidly to the top of the nest tree and glides away.

Each watch lasts for about an hour, with additional time being required for the positioning of the observers. Expensive spotlights are not required.

This paper describes the results of two recent surveys using this technique.

**Background**

In 1980 a joint working party was established by the Fisheries and Wildlife Division, Ministry for Conservation (FWD), and the Forests Commission, Victoria (FCV). Its task was to establish guidelines for forest management to conserve Leadbeater's Possum in areas of reserved forest nominated by the Land Conservation Council (Land Conservation Council 1977).

As part of the working parties program it was decided that three areas known to carry multiple colonies of Leadbeater's Possum would be nominated as deferred harvesting zones, i.e. the FCV would undertake to defer harvesting until more precise management plans can be drawn up. ('Colony' is here used to mean a single, matriarchal group, as defined by Smith (1980).)

The areas chosen were at Cambarville (37° 34'S, 145° 53'E), Upper Thomson River (37° 46'S, 146° 09'E) and Snobs Creek Road (37° 24'S, 145° 56'E), and are shown in Figure 1.

Preliminary examinations of Snobs Creek Road and Upper Thomson River were made in November 1980 and July 1981 respectively, by representatives from both FWD and FCV.

On the basis of these preliminary examinations it was decided to institute one-night surveys at both sites.

Since Smith (1980) had carried out his field study at Cambarville, and the Fisheries and Wildlife Division had a

* Arthur Rylar Institute for Environmental Research, 123 Brown Street, Heidelberg, Victoria 3084

† Ecological Studies Section, Forests Commission Victoria, Mountain Forest Research Station, Sherbrooke, Victoria 3789

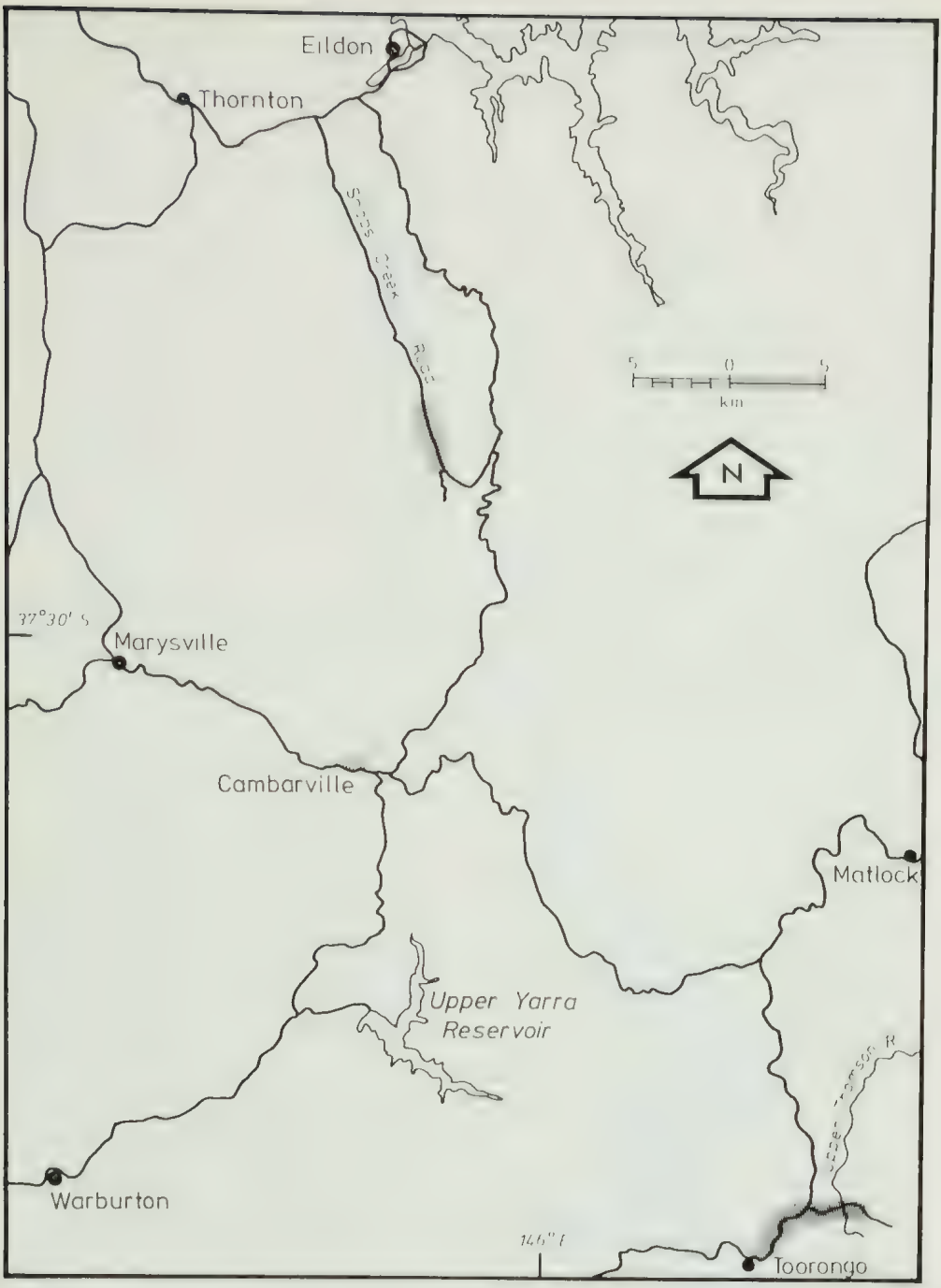



Fig. 1. Location of study sites.

continuing field study at that site, it was considered unnecessary to carry out further surveys for Leadbeater's Possum at Cambarville, although the area was assessed and tentative boundaries agreed upon on site by the working party, and it

was agreed that the boundaries of the existing Forest Park should be extended to incorporate all known colonies as established by Smith (1980).

**Methods**

The surveys were carried out on 15 December 1981 (Snobs Creek Road) and 31 March 1982 (Upper Thomson River).

Prior to the survey evenings, two of us (GCS and MAM) examined the areas and selected and marked some potential nest trees (see Figures 2 and 3). These trees were selected on the basis of size, availability of potential nest hollows, accessibility to the possums and suitable adjacent understorey habitat. Observers were stationed at these sites before dusk, and, for about 1 hour encompassing sunset, noted all possum species and numbers seen or heard in their immediate vicinity. On 4 October 1982, JHS and GCS re-examined the Snobs Creek Road area and counted and mapped all potential nest trees visible from the road.

**Results**

The results are presented in Tables 1 and 2. At Snobs Creek Road 15 observers recorded a minimum of 37 possums of 5 species, while at Upper Thomson River 30 observers recorded 38 possums of 5 species. Four species *(G. leadbeateri, Trichosurus caninus, Petauroides volans* and *Petaurus australis)* were present at both sites while *Pseudocheirus peregrinus* was recorded only at Snobs Creek Road, and *Petaurus breviceps* only at Upper Thomson River.

At Upper Thomson River observers also reported vocalisation and sightings of Southern Boobook *Ninox boobook*, White-throated Nightjar *Caprimulgus mystacalis* and Australian Owlet-nightjar *Aegotheles cristatus*.

**Discussion**

Stag-watching has proved to be a simple and productive technique for rapid assessments of possum populations as well as for detailed population studies (e.g. Smith 1980). Its major drawback is the large amount of manpower required. In addition, because it was most efficient to station observers within 100m of roads in these surveys, most information was gathered close to the ecotone provided by this forest disjunction. There is still no efficient method of assessing populations of Leadbeater's Possum in habitats remote from roads or tracks. Consequently, the importance of many ash sites cannot be assessed; the recommended Snobs Creek Road deferred harvesting zone contains mainly riparian vegetation within 300m of Snobs Creek and an appropriate buffer area of open forest.

The area included in the deferred harvesting zone is about 180 ha. We assessed about 40 ha of this adjacent to the road, and counted 101 potential nest-trees of which 68 (67.3%) were living *Eucalyptus regnans*. The remainder were dead *E. regnans*. The overall density of potential nest-trees was 2.5 trees/ha. This is somewhat lower than that determined at Cambarville by Smith (1980) of 4.5-5.2 trees/ha. Actual nest-tree density at Cambarville was 0.65 trees/ha, but we are unable to provide an estimate for Snobs Creek Road. Smith (1982) has suggested a minimum potential nest-tree density in Forest Reserves of 3 trees/ha. The Snobs Creek Road area approaches this minimum and the deferring of any harvesting operations in this area should ensure the survival of *Gymnobelideus* at least until such time as specific management data are availabe for this species. The data required include the precise distribution of *G. leadbeateri*, rates of recolonisation into logged areas, the adequacy of retained streamside and other reserves for conservation, and the stage of fire succession at which Mountain Ash forests no longer provide suitable foraging areas for the possum.

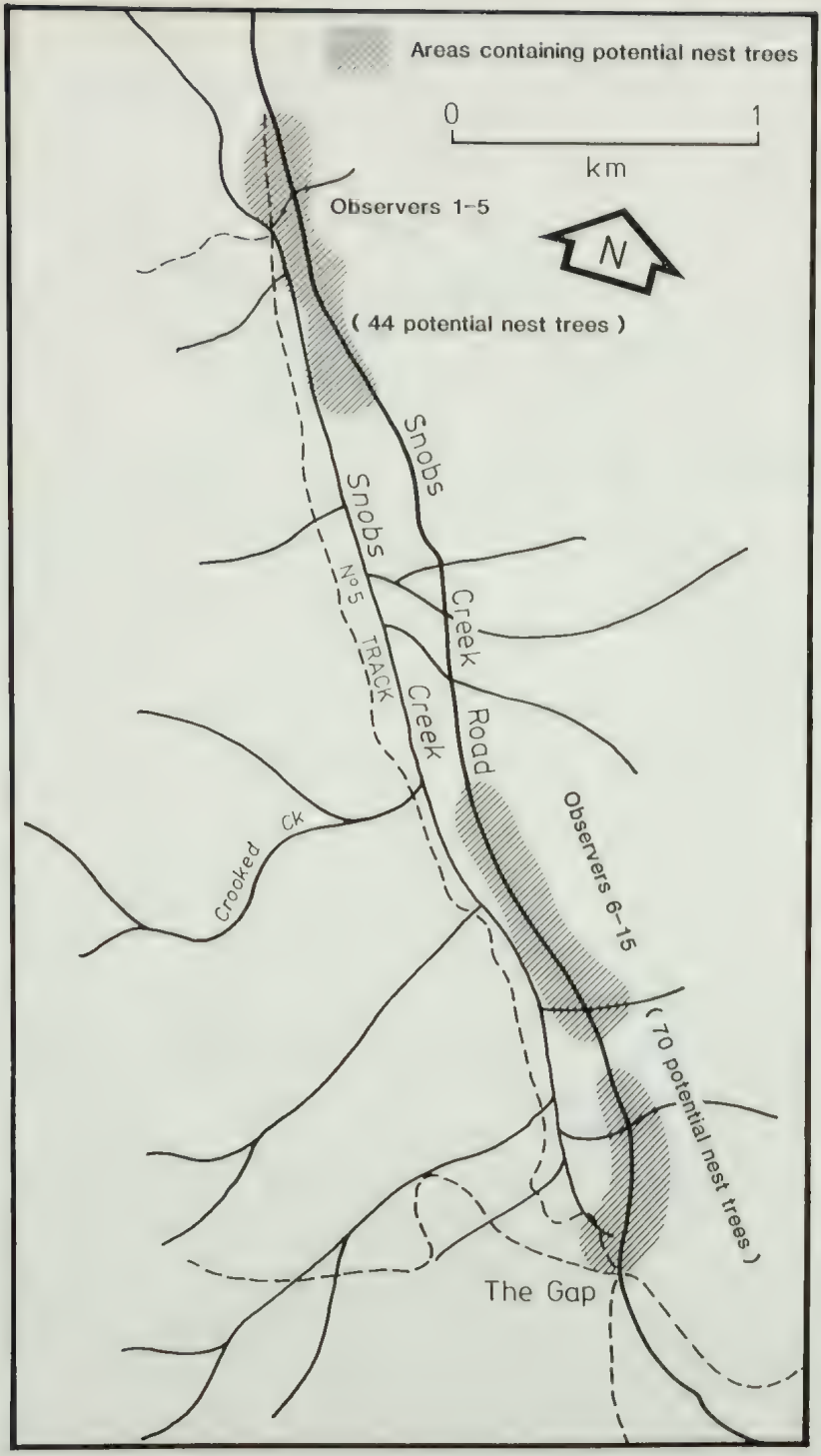



Fig. 2. Snobs Creek Road.

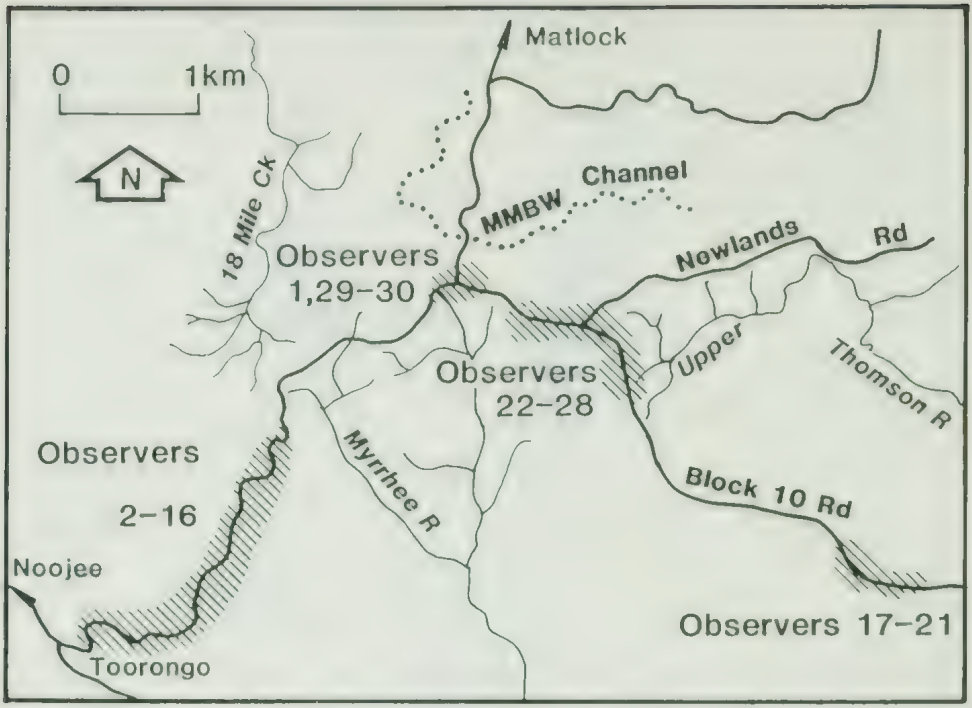



Fig. 3. Upper Thomson River Area

Table 1. Snobs Creek Road, $20^{30}$ — $21^{30}$ hours — Eastern Summer Time

| Observer | *Gymnobelideus leadbeateri* | *Trichosurus caninus* | *Petauroides volans* | *Petaurus australis* | *Pseudocheirus peregrinus* |
|---|---|---|---|---|---|
| 1 | 1 | | | | |
| 2 | | | | | |
| 3 | 2 + 2* | 3 | 1 | | 2 |
| 4 | 2 + 1* | | 2 | | |
| 5 | 2 | | | | |
| 6 | 3 | | | | |
| 7 | 1 | | | | |
| 8 | | | | | |
| 9 | 5 | | | | |
| 10 | | | 1 | | |
| 11 | 3 + 1* | | 1 | | |
| 12 | | 2 | | 2 | |
| 13 | | | 2 | | |
| 14 | 1 | 1 | | | |
| 15 | | | | | |
| TOTAL | 20 + 4* | 6 | 7 | 2 | 2 |

* It is possible that these observers counted the same animals twice. Therefore we have listed a minimum positive record with possible maximum number

Table 2. Upper Thomson River, $18^{00}$ — $19^{30}$ hours — Eastern Summer Time

| Observer | *Gymnobelideus leadbeateri* | *Trichosurus caninus* | *Petauroides volans* | *Petaurus australis* | *Pseudocheirus peregrinus* |
|---|---|---|---|---|---|
| 1 | 2 | 2 | | | |
| 2 | 4 | 2 | | | , |
| 3 | | | | | |
| 4 | | + | | | , |
| 5 | | | 2 | | |
| 6 | | , | | | , |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| 11 | | | 1 | | |
| 12 | | | 1 | | |
| 13 | | | 2? | | |
| 14 | | | 2 | | |
| 15 | 1 | | 1 | | |
| 16 | | | | | |
| 17 | | | 2 | 3 | |
| 18 | | | | | |
| 19 | | 3 | | | |
| 20 | | | | | |
| 21 | 1 | | | | |
| 22 | | | | , | |
| 23 | | | | | |
| 24 | | | | | 1 |
| 25 | | | | | |
| 26 | | | | + | 1 |
| 27 | | 2 | | + | 1 |
| 28 | | | | + | |
| 29 | | 4 | | + | |
| 30 | | , | | | |
| TOTAL | 8 | 13 | 11 | 3 | 3 |

\+ vocalisation only reported
? may have been *Trichosurus caninus*

The results from Upper Thomson River, while encouraging, did not satisfy us, and further investigation of that district is warranted.

**Acknowledgements**

We wish to thank staff from the Forests Commission and Fisheries and Wildlife Division who were observers, especially FCV staff from Alexandra and Neerim Forest Districts. Alicia McShane (FWD) drew the figures, and the manuscript was typed by Yvonne Hess and Lyn Sharpe.

REFERENCES

Land Conservation Council (1977). Melbourne Study Area, Final Recommendations (Govt. Printer: Melbourne).

Smith, A. P. (1980). The diet and ecology of Leadbeater's Possum and the Sugar Glider. Unpubl. Ph.D. Thesis, Monash University.

Smith, A. P. (1982). Leadbeater's Possum and its Management. In: Species at Risk: Research in Australia, R. H. Groves and W. D. L. Ride (Eds.) pp 129-145, Australian Academy of Science, Canberra.

Wilkinson, H. J. (1961). The rediscovery of Leadbeater's Possum. Victorian Nat. 78, 97-102.

# A Survey of the Aphodiinae, Hybosorinae and Scarabaeinae (Coleoptera: Scarabaeidae) from Small Wet Forests of Coastal New South Wales, Part 3: Buladelah to Taree.

By G. A. Williams* and T. Williams*

**Abstract**

Records of Aphodiinae, Hybosorinae and Scarabaeinae from wet forest types at Buladelah, Wallingat, Kiwarrak and Yarratt State Forests and Wingham Brush are listed. Data includes dates of collection, numbers of individuals encountered, vegetation and soil type, groundcover and bait type or collection method used. The occurrence of partial carpophagy is recorded for the genus *Lepanus* and distribution extensions are noted for several species.

**Introduction**

The first two parts of this study surveyed the wet forests from Nowra to Newcastle (Williams and Williams 1982) and the high altitude and associated escarpment forests from the Barrington Tops to the Comboyne Plateau (Williams and Williams 1983).

Part 3 surveys a variety of forest habitats from Buladelah on the lower north coast of New South Wales to just north of Taree. The dung beetle fauna of this region appears almost unknown as Matthews (1972, 1974, 1976) records only *Cephalodesmius armiger* Westwood and *Diorygopyx asciculifer* Matthews from Wingham and *Amphistomus speculifer* Matthews and *Onthophagus sydneyensia* Blackburn from Buladelah.

The region is rich in wet sclerophyll forest and rainforest types developed along creeks and gullies, frequently with a distinct rainforest understorey developed below emergent eucalypts such as the Flooded-gum, *Eucalyptus grandis* W. Hill ex Maiden. Many of the drier forest types possess small seasonally dry creeks and shallow run-off gullies dominated by *Melaleuca/Callistemon* communities in association with venturesome or marginal rainforest genera such as *Glochidion*, *Synoum* and *Alphitonia* whilst the larger perennial creeks on farm lowlands are often encompassed by a distinct wet forest community dominated by the tree *Syzygium floribundum* F. Muell. and the large wattle, *Acacia melanoxylon* R. Br. Of particular interest is the Wingham Brush site as this small dry/subtropical rainforest stand (8 hectares) represents almost 10% of the remaining alluvial subtropical rainforest in New South Wales.

In addition to sampling in wet forest communities, some comparative pit-fall trapping and incidental collecting, was undertaken in dry sclerophyll forest at Yarratt State Forest to the north of Taree and Wingham. This data follows that given in Table 1 for wet forest study sites. Yarratt is primarily a lowland dry sclerophyll forest with few wet forest communities to be found in its southern and central sections though creek and gully wet sclerophyll forest and rainforests are common in the north where the forest approaches the Comboyne Plateau. This area however, was not sampled.

Baited pit-fall traps were continued to be used to capture the beetles and, on occasions, a range of bait types were simultaneously offered. A map of the study sites is given in Fig. 1 and descriptions of site vegetation, soil type and groundcover are given briefly in Table 1. A list of species encountered is given in

* c/o Post Office, Lansdowne via Taree, N.S.W. 2430.


Figure 1. Map of study sites.
A. Buladelah State Forest.
B. Wallingat State Forest.
C. Kiwarrak State Forest.
D. Wingham Brush.
E–F. Yarratt State Forest (wet forest types).
G–L. Yarratt State Forest (dry sclerophyll types).

Table 2. A more precise location of study sites in Yarratt State Forest is given in Fig. 2 and the distribution of rainforest, wet sclerophyll and wet sclerophyll forest with a significant rainforest understorey is illustrated for that state forest.

**Discussion**

The small, creek restricted, rainforest/wet sclerophyll forest communities at Buladelah (A), Wallingat (B) and Yarratt State Forest (F) possess a relatively rich and diverse, typically "wet forest", dung beetle fauna. Sampl-

Table 1. List of study sites and species taken at each.
(Dates of collection are followed by figures in parenthesis indicating the number of specimens taken.)

A. Buladelah State Forest; adjoining southern section of the O'Sullivan's Gap Flora Reserve. Wet sclerophyll forest with well developed rainforest understorey along creek. Grey clay-loam soil with light leaf litter and fern groundcover.

*Liparochrus fossulatus* Westwood. 1.x. 1977, (1); 13.xi. 1977, (2); 1.xii. 1979, (4), at faeces.
*Amphistomus speculifer* Matthews. 13.xi. 1977, (2); 1.xii. 1979, (5), at faeces.
*Aulacopris maximus* Matthews. 13.xi. 1977, (1), at faeces.
*Cephalodesmius armiger* Westwood. 1.iv. 1977, (4); 13.xi. 1977, (1); 20.iv. 1979, (1); 1.xii. 1979, (2), at faeces.
*Diorygopyx asciculifer Matthews.* 1.iv. 1977, (8); 16.x. 1977, (7); 21.ix. 1979, (4); 1.xii. 1979, (4), at faeces.
*Lepanus bidentatus* (Wilson). 13.xi. 1977, (1); 11.xii. 1980, (1), at faeces.
*Monoplistes leai* Paulian. 13.xi. 1977, (5); 6.i. 1978 (1), at faeces and u/v light.
*Notopedaria sylvestris* Matthews. 28.v. 1978, (1), at faeces.
*Onthophagus arrilla* Matthews. 1.iv. 1977, (3); 15.x. 1977, (3); 13.xi. 1977, (6); 18. ix. 1978, (1); 1.xii. 1979, (2), at faeces.
*Onthophagus bornemisszai* Matthews. 13.xi. 1977, (1); 1.xii. 1979, (3), at faeces.
*Onthophagus kiambram* Storey. 18.ix. 1978, (1); 20.iv. 1979, (1), at faeces.
*Onthophagus leanus* Goidanich. 6.i. 1978, (1), at faeces.
*Onthophagus neostenocerus* Goidanich. 1.iv. 1977, (1); 16.x. 1977, (3); 13.xi. 1977, (1); 6.i. 1978, (4), at faeces.
*Onthophagus* sp. near *nurubuan* Matthews. 6.i. 1978, (6), at faeces.
*Onthophagus sydneyensis* Blackburn. 1.iv. 1977, (3); 16.x. 1977, (2); 1.xii. 1977, (2); 18.ix. 1978, (1); 1.xii. 1979, (2); 11.xii. 1980, (2), at faeces.

B. Wallingat State Forest; western end of Yarrie Road adjoining the northern section of the Sugar Creek Flora Reserve. Depauperate rainforest — wet sclerophyll forest complex, creek restricted, and developed below *Acacia* and *Eucalyptus* emergents. Grey brown sandy loam with medium density leaf litter coverage.

*Cephalodesmius armiger* Westwood. 30.ix. 1981, (1), at faeces.
*Lepanus bidentatus* (Wilson)? 27.x. 1981, (1), at faeces.
*Monoplistes leai* Paulian. 27.x. 1981, (1), at faeces.
*Onthophagus arrilla* Matthews. 30.ix. 1981, (8); 27.x. 1981, (1), at faeces and chicken bones.
*Onthophagus kiambram* Storey? 30.ix. 1981, (2), at faeces and chicken bones.
*Onthophagus pugnax* Harold. 30.ix. 1981, (1), at chicken bones.
*Onthophagus sydneyensis* Blackburn. 30.ix. 1981, (2), at faeces.

C. Kiwarrak State Forest; approximately 1 km north of Breakneck Lookout. Dry type rain forest on steep slope, grey clay-loam soil with medium density leaf litter and herb coverage of forest floor.

*Liparochrus silphoides* Harold. 13.x. 1981, (2), at applecores.
*Diorygopyx asciculifer* Matthews. 13.x. 1981, (4); 17.ii. 1982, (5), at faeces.
*Lepanus australis* Matthews. 13.x. 1981, (3); 17.ii. 1982, (3), at faeces and applecores.
*Lepanus bidentatus* (Wilson)? 13.x. 1981, (6); 17.ii. 1982, (3), at faeces and applecores.
*Onthophagus pugnax* Harold. 13.x. 1981, (14), at faeces.
*Onthophagus sydneyensis* Blackburn. 13.x. 1981, (5); 17.ii. 1982, (2), at faeces and marsupial droppings.

D. "Wingham Brush"; Wingham. Remnant example (approx. 8 hectares) of alluvial rainforest developed on the Manning River flood plain. Sandy loam soil with heavy infestation of forest floor by the introduced Wandering Jew *(Tradescantia).*

*Liparochrus silphoides* Harold. 10.ii. 1980, (1); 12.x. 1981, (3), at faeces.
*Cephalodesmius armiger* Westwood. 10.ii. 1980, (6); 12.x. 1981, (10), at faeces.
*Diorygopyx asciculifer* Matthews. 10.ii. 1980 (3); 12.x. 1981, (18), at faeces.
*Onthophagus neostenocerus* Goidanich. 10.ii. 1980, (1); 12.x. 1981, (1), at faeces.
*Onthophagus pugnax* Harold. 10.ii. 1980, (1), at faeces.

E. Yarratt State Forest, N.E. of Wingham. (Southern forest section, approximately 0.5 km north of junction of Main and Old Port Macquarie Roads). Seasonally dry, creek restricted depauperate wet sclerophyll assemblage established under a dry sclerophyll forest canopy. Medium to heavy leaf litter cover, brown loam soil.

*Monoplistes leai* Paulian. 7.x. 1981, (3), at faeces.
*Onthophagus sydneyensis* Blackburn. 7.x. 1981, (3), at faeces.

F. Yarratt State Forest, N.E. of Wingham. (Central forest section, junction of Graded Ridge and Eastern Boundary Roads). Creek restricted rainforest/wet sclerophyll forest assemblage; medium leaf litter cover on loam soil.

*Lepanus australis* Matthews. 8.x. 1981, (3), at faeces and chicken bones.
*Monoplistes leai* Paulian. 10.ii. 1981, (2); 8.x. 1981, (1), at faeces.
*Onthophagus kiambram* Storey. 8.x. 1981, (1), at faeces.
*Onthophagus neostenocerus* Goidanich. 23.iv. 1981, (1), at faeces.
*Onthophagus pugnax* Harold. 23.iv. 1981, (1), at faeces.
*Onthophagus sydneyensis* Blackburn. 10.ii. 1981, (1), at faeces.

G. Yarratt State Forest, N.E. of Wingham (Southern forest section immediately adjoining Site E.). *Casuarina* dominated dry sclerophyll forest. Medium density leaf litter cover (prior to August 1981), brown loam soil.

*Onthophagus dandalu* Matthews? 10.ii. 1981, (1), at faeces.
*Onthophagus dunningi* Harold. 23.iv. 1981, (2), at faeces.
*Onthophagus leanus* Goidanich. 10.ii. 1981, (1), at faeces.
*Onthophagus macrocephalus* Kirby. 10.ii. 1981, (17); 21.iv. 1981, (1), at faeces.
*Onthophagus tweedensis* Blackburn. 10.ii. 1981, (3); 23.iv. 1981, (1); 7.x. 1981, (1), at faeces.

H. Yarratt State Forest, N.E. of Wingham. (Central forest section immediately adjoining Site F.) Dry sclerophyll forest, but with adventitious wetter forest species forming a low percentage of the understorey element. Medium density leaf litter cover (prior to August 1981); brown loam soil.

*Monoplistes leai* Paulian. 10.ii. 1981, (5); 7.x. 1981, (1), at faeces.
*Notopedaria sylvestris* Matthews? 10.ii. 1981, (1), at faeces.
*Onthophagus auritus* Erichson. 8.x. 1981, (1), at faeces.
*Onthophagus leanus* Goidanich. 8.x. 1981, at faeces.

I-L Yarratt State forest, N.E. of Wingham. (Miscellaneous sites from the upper southern to the lower northern sections of the forest.). Tall to low canopy dry sclerophyll forest.

*Aphodius lividus* Oliv. 23.xii. 1981, (1), at u/v light.

*Ataenius tweedensis* Blackburn. 23.xii. 1981, (3); 20.i. 1982, (2), at u/v light.

*Euparia* sp.? 5.ii. 1981, (1), under horse manure.

*Proctophanes sculptus* Hope. 24.iv. 1981, (3), in horse manure.

*Onthophagus atrox* Harold. 28.xii. 1981, (6); 20.i. 1982, (2), at u/v light.

*Onthophagus chepara* Matthews. 11.i. 1982, (1), at u/v light.

*Onthophagus depressus* Harold. 23.xii. 1981, (1), at u/v light.

*Onthophagus gazella* (Fab.) 23.xii. 1981, (1); 20.i. 1982, (3), at u/v light.

*Onthophagus kokereka* Matthews. 5.ii. 1981, (2), in wallaby droppings.

*Onthophagus macrocephalus* Kirby. 10.iv. 1981, (1), at faeces.

*Onthophagus* sp. near *nurubuan* Matthews. 5.ii. 1981, (2), under wallaby droppings.

Table 2. Systematic summary of species encountered. (Letters indicate sites, lower case letters indicate dry sclerophyll forest sites. Where indicated, specimens lodge in Australia National Insect Collection, Canberra).

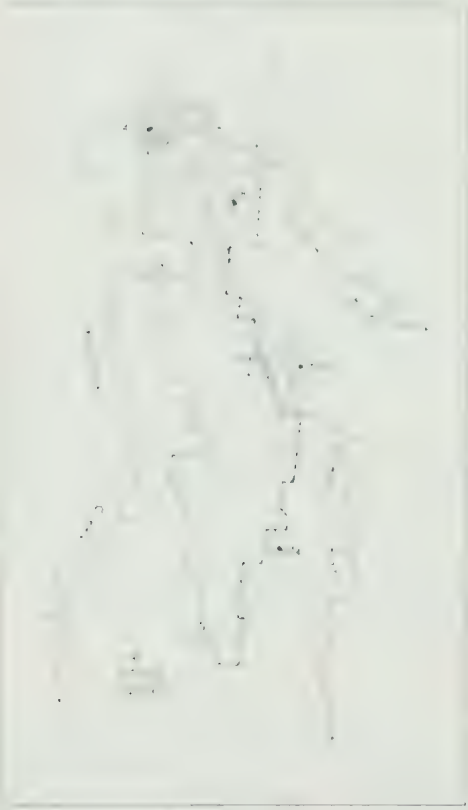


Figure 2. Yarratt State Forest

(A-B. Wet forest study sites; g-l Dry sclerophyll forest study sites; numbers indicate elevation in metres; stippled areas indicate distribution of rainforst and wet sclerophyll forest communities, this does not include dry sclerophyll types containing adventitious "rainforest" spp. as a low proportion of the understorey.)

Family Scarabaeidae.

Subfamily aphodiinae.

*Aphodius lividus* Oliv. j.

*Ataenius tweedensis* Blackburn. j.

*Euparia* sp.? k.

*Proctophanes sculptus* Hope. k. Specimen in A.N.I.C.

Subfamily Hybosorinae.

*Liparochrus fossulatus* Westwood. A. Specimens in A.N.I.C.

*Liparochrus silphoides* Harold. C, D. Specimen in A.N.I.C.

Subfamily Scarabaeinae.

Tribe Onthophagini.

*Onthophagus arrilla* Matthews. A. Specimens in A.N.I.C.

*Onthophagus atrox* Harold, j,l. Specimens in A.N.I.C.

*Onthophagus auritus* Erichson. h.

*Onthophagus bornemisszai* Matthews. A. Specimen in A.N.I.C.

*Onthophagus chepara* Matthews. l.

*Onthophagus dandalu* Matthews? g.

*Onthophagus depressus* Harold. k.

*Onthophagus gazella* (Fab.). j,k,l. Specimens in A.N.I.C.

*Onthophagus kiambram* Storey. A,F. Specimen in A.N.I.C.

*Onthophagus kiambram* Storey? B. Specimen in A.N.I.C.

*Onthophagus kokereka* Matthews. i.

*Onthophagus macrocephalus* Kirby. g,l. Specimens in A.N.I.C.

*Onthophagus neostenocerus* Goidanich. A,D,F. Specimen in A.N.I.C.

*Onthophagus* sp. near *nurubuan* Matthews. (2 spp?) A,i. Specimens in A.N.I.C.

*Onthophagus leanus* Goidanich. A,g,h. Specimen in A.N.I.C.
*Onthophagus pugnax* Harold. B,C,F. Specimen in A.N.I.C.
*Onthophagus sydneyensis* Blackburn. A,B,C,E,F. Specimens in A.N.I.C.
*onthophagus tweedensis* Blackburn. g. Specimen in A.N.I.C.
Tribe Scarabaeini.
*Amphistomus speculifer* Matthews. A.
*Aulacopris maximus* Matthews. A.
*Cephalodesmius armiger* Westwood. A,B,D. Specimens in A.N.I.C.
*Diorygopyx asciculifer* Matthews. A,C,D. Specimens in A.N.I.C.
*Lepanus australis* Matthews. C,F. Specimen in A.N.I.C.
*Lepanus bidentatus* (Wilson). A. Specimen in A.N.I.C.
*Lepanus bidentatus* (Wilson) ? B,C. Specimens in A.N.I.C.
*Monoplistes leai* Paulian. A,B,E,F,h. Specimens in A.N.I.C.
Tribe Coprini.
*Notopedaria sylvestris* Matthews. A.
*Notopedaria sylvestris* Matthews ? h.

ing in Yarratt State Forest (compare site F with sites g-l) indicated that the depauperate wet forest community there possesses a distinct dung beetle fauna to surrounding dry sclerophyll forest though one species, *Monoplistes leai* Paulian, entered the adjoining dry/wet forest interface. The species is also known to enter pasture (Allsopp 1975). The marginal, creek restricted, wet forest community (site E) at the southern end of Yarratt State Forest possessed a much reduced fauna composed of *Monoplistes leai* and *Onthophagus sydneyensis* Blackburn, both primarily wet forest species that will enter drier vegetation zones.

It is of interest to note that sampling at site E, on the 10 February and the 23 April 1981, prior to a control burn of

Fig. 3. Wingham Brush, showing proximity of the rainforest to the township. Arrows indicate the extent of the rainforest remnant. The horizon is formed by the mountains of Kiwarrak State Forest to the south.

surrounding dry sclerophyll forest in August of that year, produced no dung beetles though large numbers of the carabid beetle genus *Mystropomus* were present in the pit traps on both occasions. *Mystropomus*, however, were absent when dung beetles were taken on the third sampling visit on 7 October 1981.

No beetles were collected in pit traps set at site h (Yarratt S.F.) on the 23 April 1981, nor were dung beetles taken at traps set, during periods of local drought, at Wallingat State Forest in late January 1981 and at Buladelah State Forest in the spring of 1979.

The Buladelah site has proved the most rich in numbers of species of any of the forests we have yet sampled. 15 species are recorded from it and many of these are species representing interesting distribution extensions or species previously poorly known.

As only *Cephalodesmius armiger*, *Diorygopyx asciculifer*, *Amphistomus speculifer* and *Onthophagus sydneyensis* have been previously recorded from the wet forests of this part of our study (Matthews 1972 and 1974) all the remaining species listed constitute new records for the region. Several records, however, are of particular interest; *Monoplistes leai* was previously recorded only from the New South Wales-Queensland border area (Matthews 1974, Allsopp 1975, 1977) and *Notopedaria sylvestris* Matthews was known from far northeastern New South Wales and southeast Queensland (Matthews 1976). *Onthophagus arrilla* Matthews and *O. kiambram* Storey had been recorded from the New South Wales-Queensland border area and from southeast Queensland respectively (Matthews 1972, Storey 1977) and have more recently been collected from the Barrington Tops and Comboyne region (Williams and Williams 1983). In addition to species collected from wet forest sites, several interesting distribution records are noted for species from dry sclerophyll forest sites. *Onthophagus atrox* Harold had not been recorded south of Glen Innes and Coffs Harbour, northern New South Wales, and *O. kokereka* Matthews had been recorded from Glen Innes and Woodburn north into Queensland as far as Townsville (Matthews 1972). The occurrence of *Onthophagus tweedensis* Blackburn in *Casuarina* dominated dry forest at site g is a minor extension southward from Kendall, approximately 40 kms to the northeast.

Two Scarabaeini, *Amphistomus primonactus* Matthews and *Aptenocanthon hopsoni* (Carter), that were common in wet forest to the north and west (Williams and Williams *loc. cit.)* at higher elevations, do not appear to extend further eastward and are absent from this study area. *A. hopsoni* is very common in wet forests at Barrington Tops and extends from there in a northeasterly direction to the Comboyne Plateau, where it is found as a significant element of the fauna, but does not penetrate to wet forests of the coastal plain. In this *Aptenocanthon hopsoni* closely mirrors *Lepanus illawarrensis* Matthews from montane localities from the west and south of Sydney. *L. illawarrensis* occurs at Mt Wilson, as a conspicuous element of the rainforest fauna, and extends southwards approximating the coast only along the Wollongong escarpment (Matthews 1974, Williams and Williams 1982).

Aphodiinae were not collected during sampling visits at wet forests in this study part but 4 species, *Aphodius lividus* Oliv., *Ataenius tweedensis* Blackburn, *Euparia* ? and *Proctophanes sculptus* Hope, were collected in dry sclerophyll forest at Yarratt State Forest. Paulian (1980) does not record any hybosorines from this region but 2 species of the genus *Liparochrus*, *L. silphoides* Harold and the closely related *L. sculptilis* Westwood, are listed by him

from the Barrington and Tomalla Tops to the west.

Two species of the scarabaeine genus *Lepanus*, *L. australis* Matthews and *L. bidentatus* (Wilson) ?, were collected in applecore baited pit traps at Kiwarrak State Forest. The beetles were present at applecores in greater numbers than at faeces baited traps simultaneously offered. No dung beetles were collected from fresh fish flesh, offered as a third bait choice on the same trapping period. *Lepanus* (as *Panelus)* has previously been recorded as occurring at the fruits of *Pisonia* (Paulian 1934, 1980). Insects are actually trapped by the sticky *Pisonia* seeds (Matthews 1974) so that records from the seeds of *Pisonia* may not necessarily imply carpophagous habits in dung beetles found there.

**Acknowledgments**

We would like to thank the Forestry Commission of New South Wales for permission to undertake work within areas under their care and to the Director, New South Wales National Parks and Wildlife Service, for kindly providing information on vegetation types. Dr E. G. Matthews, South Australian Museum, Mr T. Weir, C.S.I.R.O. and Mr R. Storey, D.P.I. (Qld.) kindly assisted with a number of identifications and Mr G. Brown, Department of Agriculture, Rydalmere, provided information on the Hybosorinae within the Department's collection. We are especially thankful to the following individuals for their comments, advice and the provision of reference material; Mr T. Weir, Mr M. Dodkin (N.P.W.S.), Mr G. King (Forestry Commission), Dr T. Kingston (Australian Museum) and Mrs M. Booker (Wingham Brush Regeneration Group).

REFERENCES

Allsopp, P. G., (1975). Dung beetles (Coleoptera: Scarabaeidae) collected in the Toowoomba district, south-east Queensland. *Aust. ent. Mag. 2(3):* 47-49.

Allsopp, P. G., (1977). Further records of dung beetles (Coleoptera: Scarabaeidae) from the Toowoomba district. *Aust. ent. Mag. 3(6):* 101-103.

Matthews, E. G. (1972). A revision of the Scarabaeine dung beetles of Australia. 1. Tribe Onthophagini. *Aust. J. Zool., Suppl. Ser. 9:* 1-330.

Matthews, E. G., (1974). A revision of the Scarabaeine dung beetles of Australia. 2. Tribe Scarabaeini. *Aust. J. Zool., Suppl. Ser. 24:* 1-221.

Matthews, E. G., (1976). A revision of the Scarabaeine dung beetles of Australia. 3. Coprini. *Aust. J. Zool., Suppl. Ser. 38:* 1-52.

Paulian, R., (1934). Essai sur les Canthonides de la region australienne. *Bull. Soc. ent. Fr. 39:* 275-288.

Paulian, R., (1980). Revision taxonomique des *Liparochrus* Erichson, genre Australo-melanesien des Coleopters Hybosoridae, Scarabaeoidea. *Ann. Soc. ent. Fr.* (N.S.) *16(3):* 389-433.

Storey, R. I., (1977). Six new species of *Onthophagus* Latreille (Coleoptera: Scarabaeidae) from Australia. *J. Aust. ent. Soc., 16:* 313-320.

Williams, G. A. and Williams, T., (1982). A Survey of the Aphodiinae, Hybosorinae and Scarabaeinae (Coleoptera: Scarabaeidae) from small wet forests of coastal New South Wales, Part 1: Nowra to Newcastle. *Aust. ent. Mag. 9:* 42-48.

Williams, G. A. and Williams, T., (1983) A Survey of the Aphodiinae, Hybosorinae and Scarabaeinae (Coleoptera: Scarabaeidae) from small wet forests of coastal New South Wales, Part 2: Barrington Tops to the Comboyne Plateau. *Victorian Nat. 100:* 25-30.

# Observations on the Mountain Pygmy Possum, *Burramys parvus*, on Mt Higginbotham, Victoria.

By I. M. Mansergh, [A] and N. G. Walsh, [B]

**Abstract**

Results from a trapping program on the Mountain Pygmy Possum *(Burramys parvus)* conducted on the eastern and western slopes of Mt Higginbotham, Victoria, during February — April 1982, are presented and compared with results of a previous study in the same area (Gullan and Norris 1981). In the previous study, 51 *Burramys* were encountered on 96 occasions (over 4800 trapnights) whilst in the present study 50 *Burramys* were encountered on 73 occasions (1725 trapnights) including 7 females which had been tagged 23 months or more previously. During the survey period, some female *Burramys* appeared to be relatively sedentary and results suggest that there may be some sexual segregation within the population. *Burramys* was encountered in the habitat described in the previous study (closed *Podocarpus* shrubland and low woodland-open shrubland) and also in two floristic communities not previously recognised as its habitat, i.e. closed tussock grassland/sedgeland and closed shrubland. The ticks, *Ixodes fecialis* and *I. (?) tasmani* were collected from *Burramys*.

**Introduction**

The Mountain Pygmy possum *(Burramys parvus)* is the only Australian mammal restricted to the alpine and subalpine region and although first described from fossil remains from Wombeyan Caves, NSW (Broom 1896) it was not until 1966 that the first live animal was taken at the University Ski Club (USC) in the Mt Hotham Alpine Resort Area (MHARA) (Fig. 1). Subsequent discoveries were made within the MHARA, at two localities on the Bogong High Plains (Gullan and Norris 1981, Dixon 1971) and within the Kosciusko National Park (Calaby *et al* 1971). Recently *Burramys* has been discovered at Basalt Temple and south of Mt Niggerhead. The species is considered vulnerable throughout its known range (Ahern 1982).

Between May 1979 and March 1980 Gullan and Norris (1981) conducted an investigation into the occurrence of *Burramys* in the MHARA, and encountered 51 individuals on 96 occasions in over 4800 trapnights. Their results may be summarised: Within the MHARA 91 sites (established at intersections of 10" x 10" grid) were trapped (990 trapnights) and a single female captured; 3 females (4 recaptures) were taken at selected sites (787 trapnights) whilst 5 males and 10 females (10 recaptures) were taken in the USC (about 150 trapnights). Furthermore, their study method involved a mark-recapture program on a 7.5 ha grid (traps at 25m intervals) carried out on a basalt scree on the western slope of Mt Higginbotham (altitude 1700-1780m). Thirty two *Burramys* were encountered on 63 occasions (2964 trapnights). Floristic and structural data were taken at each 10" intersection within the MHARA and within the grid on the western slope at Mt Higginbotham. Eight floristic communities were identified in the MHARA, and two of these, low woodland and low open woodland, occurred on the western grid a further five sub-communities

A — Arthur Rylah Institute for Environmental Research, Fisheries and Wildlife Division, Ministry for Conservation, 123 Brown Street, Heidelberg, Vic. 3084.

B — National Herbarium of Victoria, Department of Crown Lands and Survey, Birdwood Avenue, South Yarra, Vic. 3141.

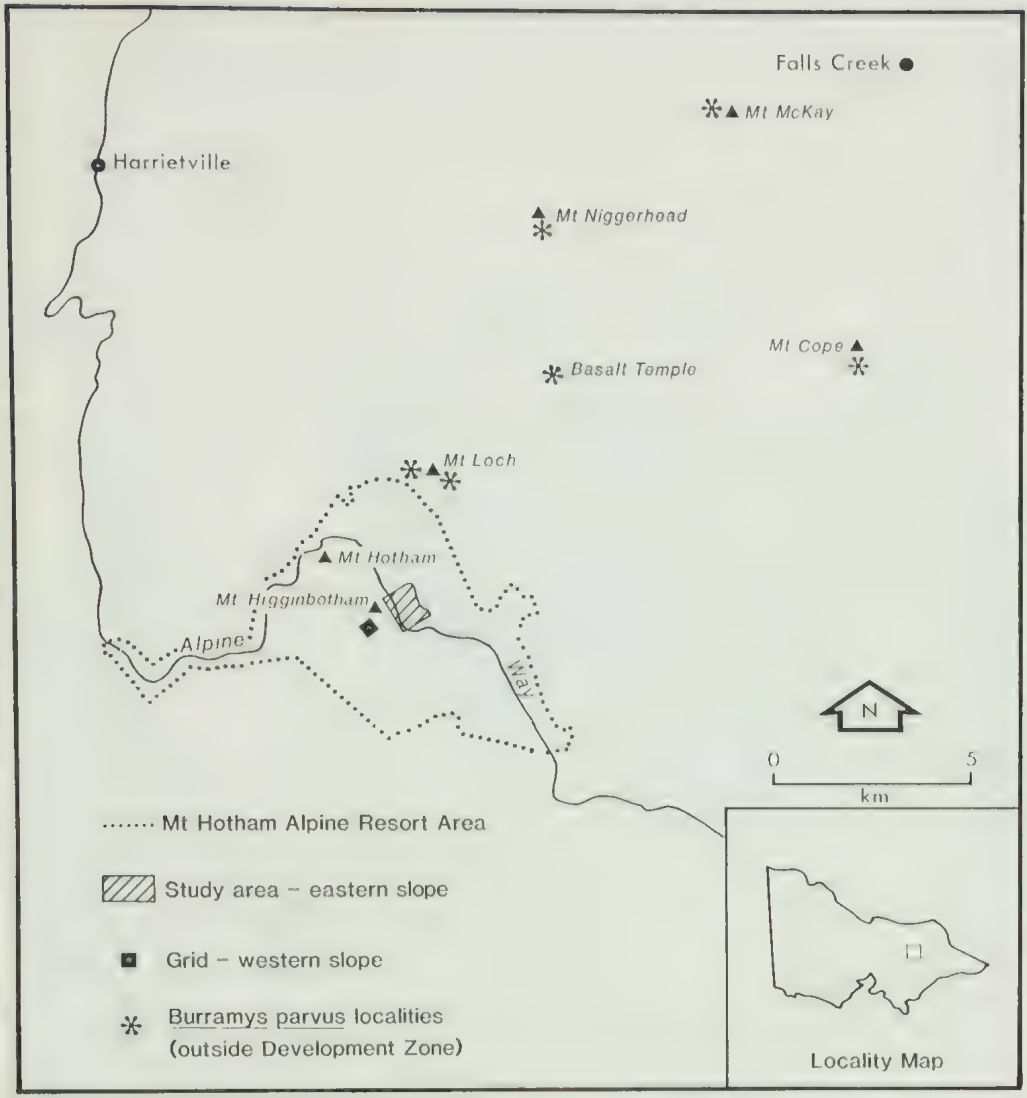



Fig. 1. The distribution of *Burramys parvus* in Victoria showing study areas in the eastern and western slopes of Mt. Higginbotham.

(including *Burramys* habitat) were identified in this area but could not be mapped throughout the MHARA due to the broader scale of sampling in the larger area (Fig. 1). Areas used by female *Burramys* were identified from floristic analysis of the western grid as closed Mountain Plum Pine *(Podocarpus lawrencei)* shrubland and low woodland-open shrubland where these overlaid basalt scree. However, the communities used by males remained unclear as only 3 males were taken on the grid (all in November), and the only other 5 males captured were taken inside the USC.

Proper management of the *Burramys* populations in Victoria and elsewhere is inhibited by lack of knowledge concerning its ecology and biology. As part of a

Fig. 2. Floristic communities and *Burramys* capture sites on the eastern slope of Mt. Higginbotham.

Explanatory Notes Fig. 2.

- Male *Burramys parvus* capture sites.
- Female *Burramys parvus* capture sites.

1. Closed Podocarp shrubland/intermittent boulderfield.
2. Low woodland/open shrubland (includes closed shrubland variant).
3. *Eucalyptus pauciflora* woodland.
4. Low open-forest.
5. Closed tussock grassland/sedgeland.
6. Wet alpine heathland.
7. Low grassy shrubland.
8. Rocky herbfield/low shrubland.
9. Dry grassland/herbfield.
10. Unvegetated basalt scree.
11. Disturbed woodland.

X. Mixture of communities 2, 2 var.,

*. Canopy removed.

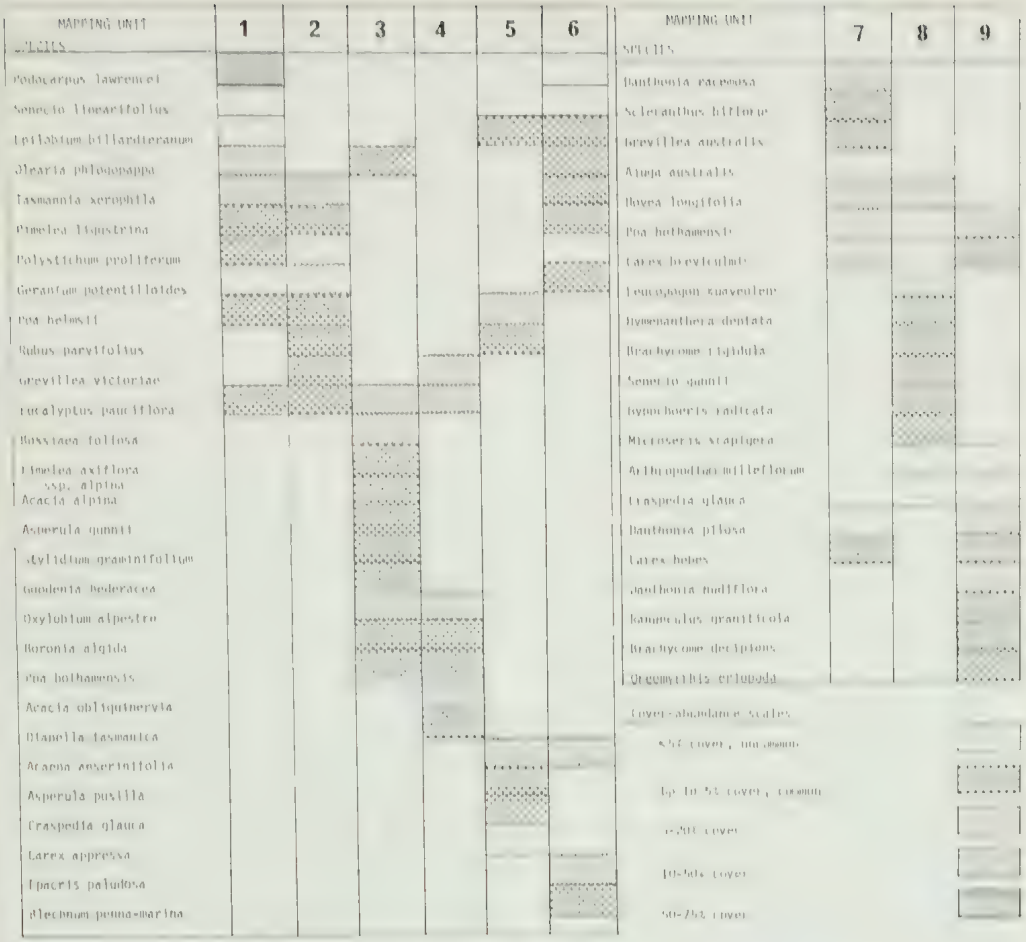



Fig. 3. Floristic composition of vegetation communities on eastern slope of Mt Higginbotham, Victoria (distribution of these communities is given in Fig. 2).

Explanatory notes Fig. 3.
1. Closed Podocarp shrubland/intermittent boulder field
2. Low woodland/open shrubland
3. *Eucalyptus pauciflora* woodland.
4. Low open-forest.
5. Closed tussock grassland/sedgeland.
6. Wet alpine heathland.
7. Low grassy shrubland.
8. Rocky herbfield/low shrubland.
9. Dry grassland/herbfield.

continuing effort to understand more about the species the MHARA was revisited in February and March-April, 1982 to more closely identify habitat utilization, to obtain data on longevity of the species and to obtain more data on the male population.

**Study Areas**

Mt Higginbotham (1800m) is situated on the Great Dividing Range in north

central Victoria (Fig. 1) and has an underlying bedrock of Ordovician sandstone and siltstone which is overlaid by a Oligocene basalt deposit (LCC 1977). This basalt has eroded leaving a cap on the peak and boulder screes down the eastern and western slopes. The vegetation ranges from alpine herbfield above about 1750m to various subalpine woodlands and shrublands at lower altitudes. In an average year snow accumulates in the area from June until September. Within this area two sampling sites were established, one on the western slope within the grid established by Gullan and Norris (1981) and the second on the eastern side of Mt Higginbotham extending from about 100m above the Alpine Way to Swindler Creek (Fig. 2). The vegetation of the latter area was identified by Gullan and Norris (1981) from analysis of data collected in the MHARA as low woodland and low open woodland. However, the extent of *Burramys* habitat remained unknown.

**Methods**

(a) Western slope grid.

At this site a trapping program was conducted between 1-6 February and 31 March-11 April, 1982 in which the methodology followed that used by Gullan and Norris (1981) i.e. one Elliot type A aluminium trap (32.5 x 10 x 9.5 cm) baited with walnut was placed at each site. Sites were revisited daily and soiled traps were replaced with others cleaned in hot water. Captured animals were examined and the sex, breeding condition (Dimpel and Calaby 1972), weight and presence of ectoparasites were recorded and individual *Burramys* were marked with numbered Monel metal fingerling ear tags.

(b) Eastern slope.

This area was visited between 1-11 April, 1982 and floristic communities were identified according to the criteria and definitions established by Gullan and Norris (1981) i.e. presence/absence of plant species in a particular community. The extent of each identified floristic community was recorded on a coloured aerial photograph of the area. In this area trapping was conducted to determine the preferred habitat selected by *Burramys*, as detailed by Gullan and Norris (1981), and also to check that other areas not previously regarded as *Burramys* habitat were in fact correctly assessed. The methodology followed that adopted within the Western slope grid. However, traps were left at selected sites for two nights along lines where they were placed at 5-25m intervals.

**Results**

Twenty-three (of 28) known *Burramys* capture sites on the western slope of Mt Higginbotham were revisited. One hundred and seventy-one trapnights were undertaken at 39 adjacent sites in February and 254 in March-April at 36 adjacent sites, and 30 individual *Burramys* were encountered on 50 occasions. Trapping success for *Burramys* in each period was 17.5% and 7.8% respectively (Table 1). On the eastern slope 1300 trapnights were undertaken and 19 *Burramys* encountered on 23 occasions with a trapping success for *Burramys* of 1.7% (Table 2). *Burramys* was captured at nine of the 20 sites visited. Nine floristic communities were identified on the eastern slopes and a further two categories were recognised, i.e. unvegetated boulder scree and disturbed woodland (interspersed with building sites) (Figs. 2 and 3). Results are summarised in Tables 1-3 and Figures 2 and 3. Communities described as closed *Podocarpus* shrubland with intermittent scree and low woodland/open shrubland are equivalent to *Burramys* habitat as described by Gullan and Norris (1981).

The sex ratios (male:female) of the captured *Burramys* population on the western grid were 1:14 in February, whilst no males were taken there in March-April, however, on the eastern

Table 1. Small mammal captures on the western slope of Mt Higginbotham, 1979-82 (Captures/100 trapnights given in parenthesis).

| | *Burramys parvus* | *Rattus fuscipes* | *Antechinus swainsonii* | Total |
|---|---|---|---|---|
| + November | 22 (5.6) | 39 (10) | - | 61 (15.6) |
| + December | 78 (17.9) | 10 (12.8) | - | 24 (30.7) |
| February | 30 (17.5) | 37 (21.6) | 19 (11.1) | 86 (50.2) |
| ++ March | 23 (9.8) | 16 (6.8) | 19 (8.6) | 58 (24.8) |
| March-April | 20 (7.9) | 88 (34.6) | 18 (7.1) | 126 (49.6) |
| + May | - | 17 (21.8) | 5 (6.4) | 22 (28.2) |

+ 1979, ++ 1980 from Gullan and Norris (1981) using data from only sites retrapped during the present study.

slope the ratio was 1:1.9. There was a significant difference between the sex ratios of the populations captured at ten *Burramys* sites (the western grid is used as one site) during March-April (L.R.$X^2$ = 31.85;10d.f.;$p < 0.001$). Using data from all studies and for all capture sites (excluding the USC) in the MHARA, in the period February-April, the sex ratios encountered at different sites remained significant (L.R.$X^2$ = 39.61: 13d.f.;$p < 0.001$).

In February, whilst no previously tagged males (3) were caught, 6 (of 29) previously-tagged females were encountered and a seventh appeared to have lost an ear tag. Of the six identifiable animals three were taken at site of last capture, one at an adjacent site and two at diagonally adjacent sites (35 m). The maximum direct distance recorded between recaptures (February and March-April) including data of Gullan and Norris (1981) was 75m. (Table 3). The average time between successive recaptures for all trapping periods on the grid was 2.7 ± 0.38 days with 40% of captured animals encountered on two or more occasions.

On the eastern slopes *Burramys* was recorded at 9 (of 19) sample sites and in 4 (of 9) floristic communities sampled (Figs. 2 and 3) these being closed *Podocarpus* shrubland with intermittent scree, low woodland/open shrubland, closed tussock grassland and a closed shrubland variant of low open woodland (Fig. 2). Only one animal was captured off basalt scree (Swindler Creek). Males were caught at 3 (of 9) *Burramys* capture sites and each site was in low woodland/open shrubland located mid-or upper mid-slope (Fig. 2).

Ticks were collected and identified as *Ixodes fecialis* (nymphs and larvae) and *I(?) tasmani* (adults and nymphs).

**Discussion**

Gullan and Norris (1981) found that during November-March female *Burramys* were restricted to closed *Podocarpus* shrubland with intermittent scree and low woodland/open shrubland and during the present study 91% of *Burramys* captures on the eastern slopes of Mt Higginbotham were made in these habitats (Table 2). However, *Burramys* was also found in closed tussock

Table 2. Trapping results in various floristic communities on eastern slope of Mt Higginbotham, 1-11 April, 1982 (Captures/100 trapnights given in parenthesis).

| Vegetation Community* | Trapnights (trapnights) | Captures | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Burramys parvus* | *Mastacomys fuscus* | *Rattus fuscipes* | *Antechinus swainsonii* | *Mus musculus* | Total (%) |
| 1 | 273 | 5 (1.8) | - | 62 (22.7) | 14 (5.1) | 2 (0.7) | 83 (22.7) |
| 2 | 301 | 8 8 (5.3) | - | 61 (20.3) | 15 (5.0) | 13 (4.3) | 105 (28.7) |
| 2 Variant: Closed Shrubland | 35 | 1 (1.3) | - | 5 (14.3) | 1 (2.8) | - | 9 ( 2.5) |
| 3 | 450 | - | - | 98 (21.8) | 26 (5.7) | 5 (1.1) | 129 (35.3) |
| 4 | 90 | - | - | 3 ( 3.3) | 2 (2.2) | - | 5 ( 1.4) |
| 5 | 42 | 1 (2.4) | - | 6 (14.2) | 1 (2.4) | 1 (2.4) | 9 ( 2.5) |
| 6 | 43 | - | - | 6 (17.1) | 4 (9.3) | - | 8 ( 2.2) |
| 7 | Nil | - | - | - | - | - | - |
| 8 | 36 | | 1 (2.7) | 14 (38.9) | 1 (2.7) | - | 16 ( 4.4) |
| 9 | Nil | - | - | - | - | - | - |
| 10 Unvegetated Basalt Scree. | 30 | - | - | 1 ( 3.3) | - | - | 1 ( 0.7) |
| Total | 300 | 23 (1.8) | 1 (0.07) | 256 (19.6) | 64 (4.9) | 21 (1.6) | 365 (100) |

* See Figure 3 for floristic composition of communities

grassland and a closed shrubland variant of low open woodland in this area (Fig. 2., Table 2). On the western slope grid the Bush Rat *(Rattus fuscipes)* is common and the Dusky Antechinus *(Antechinus swainsonii)* relatively less abundant in *Burramys* habitat (Table 1) and a similar situation exists on the eastern slopes. However, in the latter area where there has been more disturbance through building and ski slope development the introduced House Mouse *(Mus musculus)* is also present (Table 2).

Table 3. Range length between successive recaptures and maximum direct distance moved by Burramys parvus on the western slope of Mt Higginbotham 1979-82.

| | Range Length (m) between successive recaptures | | | Maximum direct distance (m). | | |
|---|---|---|---|---|---|---|
| Recapture | n | $\bar{x}$ | S.E. | n | $\bar{x}$ | S.E. |
| 1 | 22 | 36.8 | ± 6.6 | 8 | 44.8 | ± 7.6 |
| 2 | 14 | 12.5 | ± 3.6 | 5 | 33.2 | ± 11.4 |
| 3 | 9 | 22.3 | ± 7.8 | 3 | 72.6 | ± 19.9 |
| 4 | 6 | 33.8 | ± 4.9 | 3 | 55.3 | ± 11.7 |
| 5 | 3 | 35.0 | ±17.9 | 1 | 56 | - |
| 6 | 2 | 30.0 | ± 5.0 | 1 | 56 | - |
| 7 | 1 | 0 | - | 1 | 56 | - |

Some female *Burramys* lived through at least three breeding seasons as 7 of the 29 females tagged by Gullan and Norris (1981) during 1979-80 were recaptured in February 1982 and at least 5 of these recaptures were initially tagged as breeding adults. Three of these recaptures were made at point of last capture and the mean distance from point of last capture was 16m. These data suggest that at least some female *Burramys* may be relatively sedentary during the periods of surveys (i.e. November-April).

Disparate ratios between the sexes of *Burramys* captured at different sites have been noted by Gullan and Norris (1981) in the MHARA (i.e. 0:1, 3:60; 0:7 and 5:20) and at Kosciusko National Park (J. Caughley, personal communication). Male trap shyness was suggested as a possible cause by Gullan and Norris (1981), however, Caughley (personal communication) has found that males have a higher propensity for recapture than females. Although results to date may be an artefact of collection, the variation between the sex ratios of captured *Burramys* at different sites is statistically significant. Some form of sexual segregation within the *Burramys* population on Mt Higginbotham during February-April is suggested. Explanation of this segregation, which is not absolute, is difficult as Dimpel and Calaby (1971) have shown that captive *Burramys* show minimal aggression between the sexes. It has been shown that lactating female long-tailed pygmy possums *(Cercartetus caudatus)* nest alone (Dwyer 1977), however, even if this were the case with *Burramys* it does not fully explain the present results as suckling by the young ceases around late January (Dimpel and Calaby 1972). This aspect of the social organization of *Burramys* warrants further research as it has important implications for proper management of the species.

The *Burramys* captured at Swindler Creek (altitude 1430m) is the lowest altitudinal record of the species in Victoria although an animal has been taken at an altitude of 1373m in the Kosciusko National Park (Dimpel and Calaby 1972). It is also notable that Swindler Creek is mid-way between the known populations on the eastern slope of Mt

Higginbotham and Spargo Hut (Figs 1 and 2). If these populations are interconnected *Burramys* must move through floristic communities that, at present, are not regarded as utilized habitat. Given the potentially conflicting land uses (e.g. development for recreational skiing) within the MHARA and also in the Mt Kosciusko National Park (Gall 1976) more research into the habitat requirements, the biology and population dynamics of *Burramys* is required. Furthermore, this research should be oriented toward developing a management plan for the conservation of this vulnerable species.

**Conservation**

Gullan and Norris (1981) concluded that the Mount Higginbotham area was significant at the highest level for the conservation of *Burramys*. This conclusion was supported by a systematic survey of East Gippsland that identified sites of zoological significance (Norris and Mansergh 1981). One (of 11) recommendation and Gullan and Norris (1981) was for a reserve that encompassed the undeveloped western slopes of Mount Higginbotham as this area contained the highest population density of *Burramys* yet recorded. Subsequent research in Kosciusko National Park and Victoria has produced no evidence to contradict this assessment (Caughley pers. comm., Mansergh 1983). In Victoria, 26 standardised trapsites were examined and compared to 3 reference sites on the western slope of Mount Higginbotham during December 1982 and February 1983 (over 5,000 trapnights). During each period over 80% of the breeding females were encountered on the reference sites, however, only 20% of the effort was expended at these sites (Mansergh 1983).

Adequate conservation of *Burramys* at Mount Higginbotham can be viewed at three levels, all of which are important. Firstly, the protection of the population on the western slope within a reserve, secondly implementation of a management plan for *Burramys* in areas where conservation is not the primary objective (the program of research mentioned above should provide data for the evaluation of the most appropriate management strategies) and thirdly a program that educates visitors as to the ecological significance and sensitivity of the area (e.g. displays, posters, etc).

**Acknowledgments**

We are indebted to K. Norris (FWD) and P. Gullan (NHV) for access to data and encouragement in the project. J. Caughley (CSIRO) provided data from Kosciusko National Park and D. Kemp (CSIRO) assisted in identifying the tick specimens whilst L. Watson (FWD) provided assistance in the statistical analyses. I. Cumming, W. Chamley, W. Emison and L. Norman (FWD) provided valuable criticism of the original manuscript, A. McShane provided drafting support and L. Sharpe (FWD) typed the manuscript.

REFERENCES

Ahern, L. A. (1982). Threatened wildlife in Victoria and issues related to its conservation. *Fish. Wildl. Pap., Vict. 27*

Anon. (1966). A relict marsupial. *Nature 212:* 225.

Broom, R. (1896). On a small fossil marsupial with large grooved premolars. *Proc. Linn. Soc. N.S.W. 10:* 563.

Calaby, J., Dimpel, H. and Cowan, I. M. (1971). The Mountain Pigmy Possum *Burramys parvus* Broom (Marsupialia) in the Kosciusko National Park, New South Wales. *CSIRO Div. Wildl. Res. Tech. Pap. 23.*

Dimpel, H. and Calaby, J.H., (1972). Further observations on the Mountain Pigmy Possum *(Burramys parvus). Victorian Nat. 89:* 101-106.

Dixon, J. M. (1971). *Burramys parvus* Broom (Marsupialia) from Falls Creek area of the Bogong High Plains, Victoria. *Victorian Nat. 88:* 133-138

Dwyer, P. D. (1977). Notes on *Antechinus* and *Cercartetus* (Marsupialia) in the New Guinea Highlands. *Proc. Roy. Soc. Qld. 88:* 69-73.

Gall, B. C. (1976). An assessment of the human impact on the Thredbo Valley ecosystem. Unpublished M. Sc. thesis, Macquarie University.

Gullan, P. K. and Norris, K. C. (1981) An investigation of environmentally significant features (Botanical and Zoology) of Mt Hotham, Victoria. *Ministry for Conservation, Victoria, Environmental Studies Series Report. 315.*

Land Conservation Council Of Victoria. (1977) *Report on the Alpine Study Area.* Land Conservation Council, Melbourne.

Mansergh, I. (1983). Report on a trapping program to locate the Mountain Pygmy Possum *(Burramys parvus)* in the Mount Hotham, Mount Loch — western Bogong High Plains areas, November 1982 — February 1983. *Arthur Rylah Institute, Env. Res. Tech. Report. No. 7.*

Norris, K. and Mansergh, I. (1981). Sites of zoological significance in East Gippsland. *Ministry for Conservation, Victoria, Environmental Studies Series Report. 321.*

# Overwintering by *Calomela juncta* Lea (Chrysomelidae) with *Melanterius vulgivagus* Lea (Curculionidae) at Brisbane, Queensland

BY T. J. HAWKESWOOD*

Many groups of beetles undergo a diapause or period of quiescence, which is interpreted by biologists as an adaptation for survival in areas with markedly fluctuating environmental conditions. Beetles may undergo diapause when climatic conditions influence their endocrine systems, which in turn inhibit their development at a particular stage of the life cycle. With diapause proper, the further development of the beetle does not progress until similar environmental conditions act upon the insect's endocrine system to break the diapause. Diapause is different from simple quiescence where the development or activity of the insect merely ceases during adverse conditions such as during cold weather in winter, and resumes again once the favourable conditions return. The term overwintering may be loosely applied to either condition.

On 27 July 1982, I was examining trees of *Eucalyptus intermedia* R. T. Baker (Myrtaceae) near the Mt. Gravatt C.A.E., Brisbane, south-east Queensland, for bark insects. I discovered a wound in the bark of one tree about 1.4 m above ground, probably an exit hole of a previously emerged Lepidopteran. Closer examination showed that a single green chrysomelid beetle, *Calomela juncta* Lea (Chrysomelidae: Chrysomelinae) and a group of eight weevils, *Melanterius vulgivagus* Lea (Curculionidae), were clustered close together in an abandoned chamber probably belonging previously to a boring moth larva. Further examination of the same tree produced a smaller group of five weevils, and another of six weevils, tightly clustered together, about 5-8 mm below the outer level of the bark layer. No further *C. juncta* were found, although I did not search extensively on nearby trees of the same *Eucalyptus* species. All beetles were collected for identification and reference purposes, and all became active after disturbance in warmer temperatures (c. 23-25°C) in the laboratory, which suggests that beetles were not undergoing a proper diapause.

Overwintering in some other Australian chrysomelids is known, although has not been recorded previously in *Calomela*. Carne (1966), studying the biology of the *Eucalyptus*-defoliating chrysomelid, *Paropsis atomaria* Olivier, in Canberra, observed that the late-emerging adults of a second generation enter a form of diapause before which they feed vigorously for several weeks, store large quantities of fat and remain sexually immature, then overwinter under bark, or in loose leaf litter. At Armidale N.S.W., I have observed adults of *Paropsis sexpustulata* Marsham overwintering, often in large numbers under loose bark of *Eucalyptus blakelyi* Maiden and *E. pauciflora* Sieb. ex Spreng. (Myrtaceae), in association with stink bugs (Hemiptera) and small numbers of other beetles (Elateridae).

Little has been recorded on the biology of *Calomela*, apart from the knowledge that the adults and larvae feed on the fresh leaves of various *Acacia* species (Mimosaceae).

* 49 Venner Road, Annerley, Brisbane, Queensland, 4103.

*Calomela juncta* appears to be confined to coastal areas of eastern Australia, ranging from just south of Sydney (Nelligen; New South Wales) to Brisbane (Queensland); adults frequent various *Acacia* species (Selman, 1979). Nothing has been recorded on the biology and distribution of *M. vulgivagus*, a small grey-brown weevil measuring about 5-6 mm in total length. It is interesting to note a single chrysomelid beetle sharing an overwintering site with the weevils.

**Acknowledgements**

I would like to thank Mr M. De Baar, Department of Forestry, Brisbane, and Mr K. J. Houston, Department of Primary Industries, Brisbane, for allowing access to collections of Coleoptera in their care. Voucher collections of the weevils will be deposited later in these collections.

REFERENCES

Carne, P. B. (1966). Ecological characteristics of the eucalypt defoliating chrysomelid *Paropsis atomaria* Ol. *Aust. J. Zool. 14:* 647-672.

Selman, B. J. (1979). A reappraisal of the Australian species of the genus *Calomela* Hope (Coleoptera: Chrysomelidae). *Aust. J. Zool. 27:* 561-584.

---

# Effects of a Bite From a Barking Spider *(Selenocosmia stirlingi* Hoog).

BY GEOFFREY ROBINSON[1] AND GRAHAM GRIFFIN[2]

The paucity of information concerning manifestations of spider invenomation in humans can often hinder the application of appropriate medical treatment. This situation is particularly serious in sparsely settled regions where access to assistance can often be delayed by travel time to medical centres.

In central Australia there are few species of spider capable of inflicting serious and prolonged discomfort in humans. Of these the Redback Spider, *Latrodectus hasselti,* Mouse Spider, *Missuleana* sp. and the Bird or Barking Spider, *Selenocosmia stirlingi* are considered the most dangerous.

**Effects of a Bite**

The following describes the clinical manifestations exhibited by a 35 year old woman thought to have been bitten by a spider and admitted to the Alice Springs Hospital four days after the bite. the bite was inflicted on the thigh while the woman was asleep. A spider was recovered from the bed clothes the next morning and was subsequently identified as a mature male Barking Spider.

The woman initially felt an itch at the bite location. Next morning the bitten area began to sting and appeared as a pink circular area about 3 cm in diameter, with two puncture marks approximately 1 cm apart within it. Over the next two hours the bite caused intense discomfort, similar to a 'wasp sting'.

Antihistamines, aspirin and codeine were taken to alleviate the pain, however the inflamed area surrounding the bite continued to increase. By nightfall the area was circular in shape, about 6 cm in diameter, red and felt 'very hot and burning'. The woman experienced nausea but no vomiting and developed a 'splitting headache behind the eyes', which was exacerbated by light. During the next three nights she also had frequency and dysuria.

The nausea and headache continued less intensely into the third day and the erythematous area was fading, but in the evening the headache became very severe, aggravated by the slightest light. The woman had a rigor, felt very nauseated and vomited. The bitten area again became hot, red and 'angry looking'. It became slightly vesiculated on the margins, and began to spread rapidly and irregularly over the thigh. By the morning of the fourth day the plaque-like lesion covered almost two-thirds of the thigh surface area. She was admitted to hospital on the fourth day without any systemic symptoms or fever, and was not distressed. The lesion was tender but not hot.

1. Alice Springs Hospital, Alice Springs, N.T. 5750.
2. C.S.I.R.O. Central Australian Laboratory, Alice Springs, N.T. 5750.

The following observations were made —

- Regional lymph nodes not enlarged or tender
- Urine contained no protein
- Erythrocyte Sedimentation Rate was 60 mm/h
- Blood count and film, serum electrolytes, serum urea and creatinine, liver function tests, microscopic examination of urine and fibrinogen degradation products in the blood were all within normal limits
- No growth on culture of the urine

The patient remained symptom-free over the next four days and the skin lesion gradually faded.

**The spider**

The Barking Spider is a terrestial burrower common in inland Australia. Its body (head and thorax) measure about 4-5 cm in mature specimens. In central Australia the spider is most active during, and for several days following, summer rains. Males of the spiders are most commonly encountered since they vacate their burrows during humid weather in search of the more sedentary females. The males do not return to their burrows but remain as vagrants until death. It is during this period they are most likely to come into direct contact with people.

Southcott (1978) reports that bites from species of *Selencosmia* can sometimes cause 'severe reactions'. A bite from a closely related larger species *(S. crassipes)* near Darwin, was reported to have killed at 4.5 kg dog within two and a half hours (C.S. Li, pers. comm.).

REFERENCE

Southcott, R. V. (1978). Australian harmful Arachnids and their allies. R. V. Southcott, 2 Taylors Road, Mitcham, South Australia 5062.

---

## Make Your Holiday Worthwhile at a Bird Observatory.

BY MARY SMALL*

Rotamah Island Bird Observatory set in the peaceful Lakes National Park in East Gippsland, Victoria, offers an ideal sanctuary not only for wildlife but also for anyone seeking an environmental holiday away from the hurly-burly of modern living. With a similar observatory already established in Western Australia at Eyre, on the edge of the Great Australian Bight, the Royal Australasian Ornithologists Union made arrangements to lease the small island of Rotamah and converted the old farmhouse into a second observatory. Since then, a third has been opened recently in New South Wales at Barren Grounds Nature Reserve inland from Wollongong. These three centres provide valuable study resources for ornithologists and for anyone interested in natural history, particularly birds and their habitat. In exchange for a willingness to participate with a few of the household chores the accommodation is cheap but comfortable, the company congenial, the environment unspoilt.

It was with a certain amount of misgiving that I accepted an invitation to spend a few days at the Rotamah Island Observatory. The friend who invited me is an active member of the Royal Australasian Ornithologists Union . . . a name awe-inspiring enough in itself but I knew that the other people attending this study weekend were ornithologists intent on discussing the various techniques of bird-banding. With my limited knowledge of birds, I would be an outsider.

From Melbourne it takes from 2½-3 hours to reach Spermwhale Head on Lake Victoria. Here, at Trapper Point cars can be parked in a bushland clearing close to the jetty. As the warden had been told of our expected time of arrival a loud hail of "Coo-eee!" brought him over from the island in the small boat. A five minute journey across the water and we had arrived. The only buildings on Rotamah are the converted farmhouse and warden's quarters set amid natural surroundings where emus strut freely. Inside is a meals room and kitchen, study and library, a number of dormitory-style rooms, toilets and bathroom. All that a visitor needs to bring is a sleeping bag, towels, sufficient suitable clothing to suit the season, stout shoes for walking,

* R.A.O.U. Headquarters, 21 Gladstone Street, Moonee Ponds, Victoria. 3039.

binoculars, camera, and insect repellent for the mosquitoes.

The invitation proved to be an example of what the R.A.O.U. and the Bird Observatories are all about. Although a number of members are experts in their field of study the Union relies greatly on the involvement of amateurs to assist with on-going surveys and research programmes to keep its pulse throbbing. Those who know only a little about birds and those who are already 'hooked' can improve their skills by attending study weekends, using the base for their own field work, meeting people with similar interests, or by just bird-watching. In the short time I was on the island I felt immediately at home and was welcome to join in with any of the discussions, help to check nests and with the mist-netting of small birds for banding, or wander around alone through peaceful forest, coastal heath, the swamps of the tidal flats, or across the land bridge to the adjacent Ninety Mile Beach. Because of the variety of habitat in such a small area the birds are prolific. There are also grey kangaroos, hog deer, and plenty of evidence of wombats and rabbits.

Anyone interested in visiting Rotamah Island or the other observatories can obtain more detail from the head-quarters of the R.A.O.U. at 21 Gladstone Street, Moonee Ponds, 3039. (Tel: 370 1272).

## Bibliography of the Writings of the Late Aldo Massola

By G. A. Crichton*

It is not expected that the following bibliography of the writings of Massola is complete, being based only upon records and material readily available; nevertheless it should prove of some value to that increasing band of students interested in the antiquity and origin of man in Australia.

As will be seen, the majority of his writings were published in *The Victorian Naturalist* and it speaks well of the foresight of that long line of editors, since 1956, who perceived the value of such work, at a time when interest in this field of research was only reawakening.

*Victorian Nat.* 73, 2, p.21, 1956: Aboriginal Paintings at Flat Rock Shelter.

*Victorian Nat.* 73, p.48, 1956: The Native Water Wells at Maryborough, Vic.

*Victorian Nat.* 73, p.65, 1956: More Paintings at Flat Rock.

*Mem. of the National Museum,* Vic. 22, (1) 1956: Australian Fishhooks and Their Distribution.

*Mem. of the National Museum,* Vic. 22, 3 1956: Vic. Aboriginal Strangling Cords.

*Victorian Nat.* 74, p.19, 1957: Bunjil's Cave Found.

*Victorian Nat.* 74, p.41, 1957: Native Well at Whroo; Goulburn Valley.

*Victorian Nat.* 74, p.63, 1957: Reinterpretation of the Cave of the Serpent.

*Victorian Nat.* 75, p.77, 1957: The Challicum Bun-yip.

*Victorian Nat.* 75, p.25, 1958: Native Burials at Gunbower.

*Victorian Nat.* 75, p.73, 1958: New Aboriginal Rock Paintings in Victoria Range.

*Victorian Nat.* 75, p.124, 1958: Vic. Aboriginal Bark Drawing in the British Museum.

*Victorian History Magazine,* 28, 1958, p.45: Notes on the Aborigines formerly Inhabiting the Goulburn Valley.

*Manking,* 5, p.289, 1959: Wooden Shovels of Aborigines of S.E. Australia.

*Mem. of the National Museum,* Vic. 24, 1959, p.103: Bibliography of Printed Literature upon Victorian Aborigines.

*Victorian Nat.* 76, p.8, 1959: Some Unusual Stone Artefacts.

*Victorian Nat.* 76, p.121, 1959: Native Water Wells at Beaumaris and Black Rock.

*Victorian Nat.* 76, p.180, 1959: History of Coast Tribe.

*Victorian Nat.* 76, p.252, 1960: Painting by Berak.

*Victorian Nat.* 77, p.97, 1960: Native Painted Shelter at Beechworth.

*Victorian Nat.* 77, p.188, 1960: Shelter at the Camp of the Emu's Foot.

*Victorian Nat.* 77, p.234, 1960: Two New Painted Shelters at Glen Isla.

*Victorian Nat.* 78, 1, p.16, 1961: Surface Archeology of Wooloomanata.

*Victorian Nat.* 78, 4, p.106, 1961: Sacred Rocks of the Aborigines: Metung and Clematis.

* 6 Ainslie Park Ave., Croydon, Vic. 3136.

*Victorian Nat.* 78, 7, p.203, 1961: Some unusual Stone Artefacts.
*Victorian Nat.* 78, 8, p.238, 1961: The Legend of Lake Buninjon.
*Mankind,* 5, p.415, 1961: A Victorian Skull-Cap Drinking Bowl.
*Victorian Nat.* 78, 9, p.275, 1962: How Flat Top Hill Came into Being; Mortlake.
*Victorian Nat.* 78, p.335, 1962: The Cave of Ghosts.
*Vic. History Magazine,* 33, p.251, 1962: History of Yelta Mission Station.
*Proc. Royal Society Vic.* 75, p.319, 1962: Aborigines of Victorian High Plains.
*Mankind,* 5, p.463, 1962: A Grooved Axe With Iron Haft.
*Australian Nat. History,* 14, p.47, 1962: Central Victorian Aboriginal Weapons.
*Victorian Nat.* 79, 4, p.110, 1962: Two Aboriginal Legends of Ballarat District.
*Victorian Nat.* 79, 3, p.66, 1962: Grinding Rocks at Gellibrand.
*Victorian Nat.* 79, 5, p.128, 1962: The Nargun's Cave at Lake Tyres.
*Victorian Nat.* 79, 6, p.162, 1962: Native Fish Traps at Toolando, Horsham.
*Aust. Nat. History,* 14, p.254, 1963: Aboriginal Relics in Victoria.
*Vic. Hist. Magazine,* 34, p.29, 1963: History of Lake Condah Reserve.
*Victorian Nat.* 79, 12, p.352, 1963: Black Range Shelters.
*Victorian Nat.* 80, 6, p.177, 1963: Native Stone Arrangements at Carisbrook.
*Proc. Royal Soc. of Victoria.* 76, p.227, 1963: The Parrying Sheilds of S.E. Australia.
*Victorian Nat.* 80, 10, p.323, 1964: Food of the Aborigines.
*Victorian Nat.* 81, 1, p.15, 1964: Records of new Shelters in Black Range.
*Victorian Nat.* 81, 4, p.109, 1964: Grinding rocks at Earlston.
*Victorian Nat.* 81, 6, p.169, 1964: Victoria Range Shelters.
*Victorian Nat.* 82, p.111, 1965: The Port Albert Frog and The White Rock.
*Mankind* 6, p.211, 1965: Some Superstitions among Lake Tyres Aborigines.
*Victorian Nat.* 82, 1, p.9 1965: The Grinding Rocks at Boisdale.
*Proc. Royal Society of Vic.* 78, p.175, 1965: The Hook Clubs of South East Australia.
*Victorian Nat.* 83, 4, p.72, 1966: Rock Shelters at Mudgegonga.
*Victorian Nat.* 83, 6, p.125, 1966: Antiquities of the Colac District.
*Proc. Royal Soc. of Vic.* 79, p.267, 1966: The Aborigines of the Mallee.
*Victorian Nat.* 83, 8, p.188, 1966: Aboriginal Antiquities of Colac District.
*Victorian Nat.* 83, 12, p.318, 1966: The Aborigines as Wild Life Conservators.
*Victorian Nat.* 84, 7, p.207, 1967: Grinding Rocks at Munro.
*Victorian Nat.* 84, 9, p.264, 1967: Honey Suckle Creek Rock Shelters.
Aboriginal Place Names of S.E. Australia and Their Meanings. Landowne, 1968.
Bunjil's Cave. Myths, Legends and Superstitions of Aborigines of S.E. Australia. Lansdowne, 1968.
*Victorian Nat.* 85, 2, p.33, 1968: Probable Stone Arrangement at Franklinford.
*Victorian Nat.* 85, 4, p.99, 1968: The Blow at Strathsfieldsaye, Gippsland.
*Victorian Nat.* 85, 5, p.132, 1968: The Spirit Cave at Craigs, East of Lake Yambuk.
*Victorian Nat.* 85, 7, p.197, 1968: Aboriginal Fish Traps at Homerton.
*Victorian Nat.* 85, 11, p.317, 1968: Gnareeb-Gnareeb Tribe of the Western Disctrict.
History of Ramahyuck Mission Station. The Gap, No. 7. 1969.
*Victorian Nat.* 86, 2, p.42, 1969: Notes on Aborigines of Donald District.
*Victorian Nat.* 86, 3, p.71, 1969: Aboriginal Camp Sites on Wyperfeld National Park and Pines Plains Station.
*Victorian Nat.* 86, 7, p.208, 1969: The Grinding Rocks at Munro.
*Victorian Nat.* 86, 8, p.233, 1969: Melbourne's Canoe Trees.
*Victorian Nat.* 86, 11, p.313, 1969: Unique Aboriginal Flint implements from Cope Cope, Victoria.
*Victorian Nat.* 86, 12, p.342, 1969: More Grinding Rocks at Munro.
The Aboriginal People, Cypress, Melbourne, 1969.
Journey to Aboriginal Victoria, Rigby, 1969.
*Victorian Nat.* 87, 1, p.4, 1970: Notes on Aborigines of Stawell District.
*Victorian Nat.* 87, 2, p.39, 1970: Aborigines Sacred Rocks on Bald Hill, Clematis, Vic.
*Victorian Nat.* 87, 10, p.299, 1970: Mortuary and other Monuments to Aborigines.
A Note on Perforated Stone Pendants. APOA, 5, p.80, 1970.
Aboriginal Mission Stations in Victoria. Hawthorn Press, Vic, 1970.

*Victorian Nat.* 88, 3, p.58, 1971: The Grinding Rocks at Stratford.

*Victorian Nat.* 88, 5, p.139, 1971: Aboriginal Paintings at Muline Creek.

*Victorian Nat.* 88, 6, p.152, 1971: Boggy Creek Painted Shelter: A new Locality record.

Bibliography of the Victorian Aborigines: Earliest Manuscripts to 1970. Hawthorn Press, 1971.

Aborigines of S.E. Australia, as they were. Heinman, 1971.

*Victorian Nat.* 89, 2, p.54, 1972: Punta Arenas and Sir. Baldwyn Spencer's Grave.

*Victorian Nat.* 89, 7, p.196, 1972: Honey Suckle Creek, No. 4, Aboriginal Shelter.

*Victorian Nat.* 90, 5, p.126, 1973: An Avoca River-Wirrengren Plain Aboriginal Trade Route.

*Victorian Nat.* 90, 10, p.280, 1973: Report of New Discoveries of Aboriginal Painted Shelters in the Victoria Range.

*Victorian Nat.* 90, 11, p.326, 1973: The "Matterhorn" Aboriginal Shelter and its Possible Mythological Significance.

*Victorian Nat.* 91, 2, p.45, 1974: Notes on the Aborigines of the Wonthaggi District.

Coranderrk: A History of the Aboriginal Station, Lowden Pub. Co. 1975.


REFERENCES

Baines, J. A., (1976). Aldo Massola, Italo-Australian Anthropologist of the Aborigines. *Victorian Nat. 93:* 91-107.

Massola, A., Bibliography of Victorian Aborigines. Hawthorn Press, 1971.


---

## *Naturalist Review*

### "How Birds Work. A Guide to Bird Biology"

BY RON FREETHY


1982. Blandford Press, Dorset, U.K. Distributed in Australia by ANZ Book Co. ISBN 0 7137 11566. Rrp $17.95. 232 pp.


This is an introductory text in ornithology. Its admirable intention is to enhance an amateur's appreciation of birds by providing the background information necessary to develop a greater understanding of just how birds work. Amateurs with a wealth of hard won observations, data and skills often feel daunted by their seeming lack of basic biological science. Yet, as Freethy correctly maintains, a sound grounding in the biology of an animal under study enhances the observer's appreciation of the subject enormously.

The book is introduced by perhaps its weakest chapter: "The Evolution of Birds". Unfortunately such a complex topic is treated too simplistically (e.g. the evolution of endothermy), the material he uses is often out of date (speciation) and some terms are misused (niche). However, the chapter does provide some useful insights into Darwin as a naturalist and should at least prod those naive enough to still believe in Adam and Eve and the fixity of species!

Then follow eleven chapters on avian tanonomy, structure and function — some of which are very well handled. Particularly well done are those on "The Bird's Body", "Flight", "Breathing, Respiration and Blood Supply" and "The Nervous System".

The book is written in an interesting style and is supported by 117 figures including 12 fine colour plates. Its author is a well-known ornithologist and is editor of the British Naturalists Associations' *Countryside* "**How Birds Work**" is recommended to naturalists and birdwatchers who might lack a biological training but who would like to broaden their understanding of the hows and whys of ornithology.

**R. Wallis**

# Notes on the Pollination and Fruit Production of *Cupaniopsis anacardioides* (A. Rich.) Radlkf. (Sapindaceae) at Townsville, North Queensland. Part II. Fruit and Seed Production.

By T. J. Hawkeswood*

**Abstract**

Observations on fruit growth of two trees of *Cupaniopsis anacardioides* (A. Rich.) Radlkf. at Townsville, indicated similar rates of development, although one tree produced larger fruit. A majority of fruit from both trees produced 2 seeds. A reasonably high percentage of flowers set fruit, while the number of fruit produced per tree was also high.

**Introduction**

In Part I (Hawkeswood 1983), I have covered aspects of the pollination and floral biology of *Cupaniopsis anacardioides* at Townsville, north Queensland. Part II concludes my research on this species, with a study of fruit production and seed set of two trees growing on the James Cook University grounds, Townsville.

**Materials and Methods**

(a) Collection of fruit material

On 23, 28 July, 3, 9, 15, 20, 26 August and 6, 16 September 1981, randomly selected samples of one fruiting inflorescence were collected from the same two trees sampled in Part I for the study of floral biology. Twenty-five fruits from each tree on each day of collection (except on 16 Sept. when 20 fruits were sampled) were measured for width as an indication of fruit growth and development. The means and standard deviations were plotted to show the changing rates of development over time (Fig. 1).

On 1 August 1981, 9 intact inflorescences with immature fruits and seeds were sampled from Trees 1 and 2. The number of fruits/inflorescence were counted and results recorded (Table 1).

On 16 September 1981, the widths of 20 fruits from each tree were measured and the data plotted (Figs. 2 and 3) to show the distribution of size classes and differences in size of fruit between the two trees.

Immature fruit specimens from each collection were preserved in 70% alcohol for further study of the developing seeds.

(b) Seed production

On 23 October 1981, some three months after the initial flowering of *C. anacardioides* on the University grounds, and about one month after the fruiting capsules had ceased growing, samples of semi-mature to mature fruit were collected from Trees 1 and 2. The pericarp of these fruit was orange-green to orange at this stage. The development of the seeds was advanced and the aril was well expanded over the testa. The number of healthy fruit containing normally developing seeds was examined and the numbers of seeds per fruit recorded (Fig. 4). Abortion, due to some physiological breakdown in the development of certain seeds, led to fruit with only one or two seeds while some were without seeds. Any small, deformed, partially decayed or insect attacked fruit in the samples taken were discarded. These represented approximately 5% of the total number of fruits examined.

**Results**

(a) The fruit and seed

The fruit is a glabrous, coriaceous, triquetrous or obtusely 3-angled, globular or ellipsoid capsule measuring

* 49 Venner Road, Annerley, Brisbane, Queensland, 4103.

Table 1. The number of immature fruits per inflorescence in 9 samples taken from two trees of Cupaniopsis anacardioides (A. Rich.) Radlkf., at Townsville, on 1 Aug. 1981.

| Tree No. 1 | | Tree No. 2. | |
|---|---|---|---|
| Sample No. | No. of fruits/ inflorescence | Sample No. | No. of fruits/ inflorescence |
| 1, 2, 3 | 37, 27, 63 | 1, 2, 3 | 23, 29, 45 |
| 4, 5, 6 | 49, 33, 42 | 4, 5, 6 | 101, 48, 63 |
| 7, 8, 9 | 62, 85, 48 | 7, 8, 9 | 58, 55, 39 |
| Total and range | 446 (27-85) | Total and range | 461 (23-101) |
| Mean and standard deviation | 49.6 ± 18.0 | Mean and standard deviation | 51.2 ± 22.8 |

from 1.5-1.8 (-2.2) cm long when mature and is shortly attenuate at the base. It is 2- or 3- locular and when mature, opens loculicidally in as many valves as cells. There is one ovule per loculus. The seeds, lacking endosperm, are arillate; the aril is fleshy and the testa of the seed is crustaceous or coriaceous.

(b) Observations on fruit growth and development

Tree 1. Between 23 July and 9 Aug. (17 days), the fruits of Tree 1 grew in width at an average rate of 0.16 mm/day (Fig. 1) and from 9 Aug. to 6 Sept. (28 days) grew at twice the rate of 0.32 mm/day before ceasing growth.

Tree 2. In contrast, the fruit of Tree 2 grew at a faster rate between 23 July and 3 Aug. (11 days) of 0.37 mm/day (Fig. 1) and between 3 Aug. and 20 Aug. (17 days) grew at the rate of 0.43 mm/day,

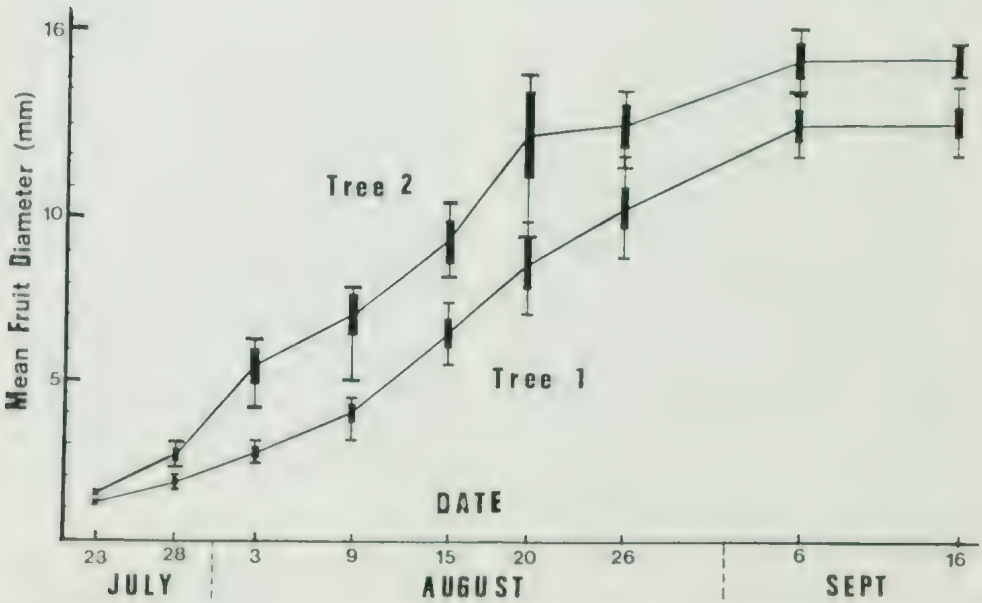



Fig. 1. Increase in width over time for the fruits of two trees of *C. anacardioides* at Townsville. (N.B. On 16 Sept. 1981, 20 fruits were sampled from each tree instead of 25).

then slowed down to only 0.14 mm/day during 20 Aug. to 6 Sept. (17 days) before ceasing growth.

The average growth rate of the fruit between 23 July and 6 Sept. 1981 (the total growth period of 45 days) for Tree 1 was 0.26 mm/day and for Tree 2 was 0.30 mm/day (data obtained from Fig. 1).

On 16 Sept. 1981 when it was evident that the fruit had ceased growing, 20 semi-mature fruits were sampled from each of Trees 1 and 2, and the diameters plotted (grouped into size classes) on a histogram (Fig. 2). The histogram clearly shows that Tree 2 fruit were much larger (except for one specimen) than those of Tree 1 (Fig. 2).

The length of each fruit sampled above on 16 Sept. was also measured. Length versus width was plotted (Fig. 3) and correlations undertaken. The relationship between fruit width and length for Tree 1 was $Y = 0.52X + 6.94$ but with a relatively low correlation coefficient of $r = 0.385$ (Fig. 3), while that of Tree 2 was similar, i.e. $Y = 0.52X + 8.69$ ($r = 0.298$) (Fig. 3). Although fruit of Tree 2 were larger, the relationship between fruit length and width was the same as Tree 1.

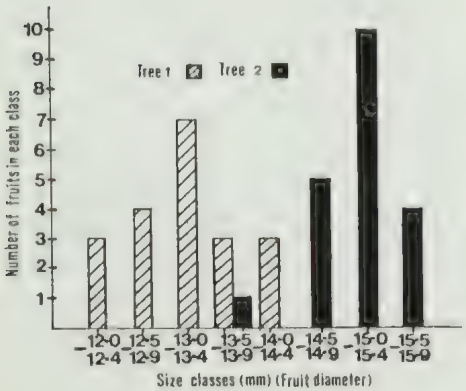



Fig. 2. Distribution of size classes for fruits from two trees of *C. anacardioides* collected on 16 Sept. 1981, at Townsville.

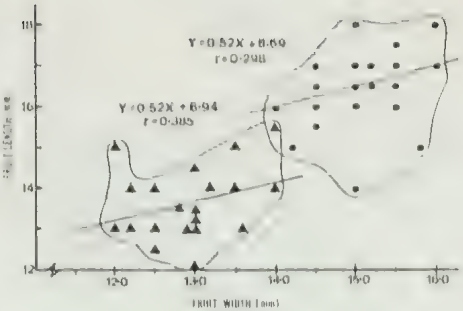



Fig. 3. Relationship between width and length for fruits from two trees of *C. anacardioides* collected on 16 Sept. 1981, at Townsville. ( ▲ - Tree 1, ● - Tree 2)

(c) Observations on fruit and seed production

On 1 Aug. 1981, about 25 days after the initial flowering of *C. anacardioides* on the University grounds, 9 samples of intact inflorescences were carefully cut from Trees 1 and 2 and placed in plastic bags. The number of fruits per inflorescence were later counted in the laboratory (Table 1). The means and standard deviations were similar for the trees (Table 1). Assuming an average of about 50 fruits per inflorescence (Table 1) being produced by *Cupaniopsis* trees and an average of about 280 flowers per inflorescence (Hawkeswood, 1983, Table 2), then pollination and fertilization success is approximately 18.4% (assuming all flowers are bisexual or the majority gyno-monoecious). This represents a relatively high level of fruit production for a mass-flowering species. Assuming c. 25,000 to 35,000 flowers can be produced by a mature tree then c. 4,600–5,400 (i.e. 9,200–10,800 seeds) may be produced by a single, mature *C. anacardioides* tree.

On 23 October 1981, 112 fruits from Tree 1 and 74 from Tree 2 were examined for seed formation. Of 112 fruit from Tree 1, 32 (28.6% of the total) produced only one seed, 55 (49.1%) produced two seeds and 25 (22.3%) produced three seeds (Fig. 4). The average number of seeds/fruit was almost 2.0 (Fig. 4). On

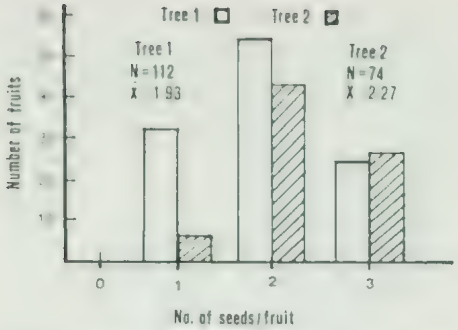



Fig. 4. Histogram showing number of fruits producing one, two or three seeds of *C. anacardioides*, at Townsville.

the other hand, Tree 2 produced only 6 (8.1% of the total) fruit with one seed, 42 (56.7%) with two seeds and 26 (35.2%) with three seeds (Fig. 4). The average number of seeds/fruit was more than 2.0 (Fig. 4). All 186 fruits examined from the two trees contained seeds (Fig. 4).

A total of 385 seeds from 186 fruits were counted, giving an overall average of 2.07 seeds/fruit (from Fig. 4).

**Discussion**

There are no published comparative studies on fruit and seed production of Australian Sapindaceae. Consequently, there is much scope for basic research to be undertaken in this area.

For *C. anacardioides* at Townsville, the fruits grow almost in a linear manner over time before reaching a maximum size about 2 months after the initial flowering. The seeds grow slowly while the fruit itself is maturing but develop rapidly over 3–4 weeks once the fruit begins to harden, shrivel and change from green to orange in colour. The aril covers (or almost covers) the seed from early growth and changes from pale green to deep orange once the fruit has changed colour.

A similar fruit growth rate occurred in the trees despite Tree 1 producing smaller fruit (and consequently smaller seeds). Both trees produced an average of almost 2.0 seeds/fruit. The majority of abortion of ovules appeared to have occurred at an early stage of their development, probably at the time when the fruit was semi-mature (c. 15–20 August or slightly later). The observation that of 186 fruits examined, all produced seeds, is significant and indicates a high level of pollination and fertilization success. However, the possibility of adventitious embryony (i.e. formation of embryos from somatic cells) occurring, can not be overlooked. A thorough embryological study is needed to shed light on the fertilization behaviour and ovule development of *C. anacardioides*.

**Acknowledgement**

The research for this paper was undertaken on private funds, and I thank my mother, Mrs D. E. Hawkeswood for facilities enabling me to complete the work.

REFERENCE

Hawkeswood, T. J. (1983). Pollination and fruit production of *Cupaniopsis anacardioides* (A. Rich.) Radlkf. (Sapindaceae) at Townsville, north Queensland. I. Pollination and floral biology. *Victorian Nat. 100:* 12–20.

Faegri, K. and Van der Pijl, L. (1976). *The Principles of Pollination Ecology.* (Permagon Press, Oxford). 248 pp.

Corrections to Part 1.

Page 18. 1st Col. Last para. — "next architecture" should read "nest architecture".

Page 19. 2nd Col. 2nd para. "more imporant" should read "more important".

The scale line on Fig. 1. (p. 16) was omitted from the original plate by the printer. The bar indicated 5 pm not 5 m as was printed in the caption.

# Red Rain — Will it Come Again to Melbourne?

By G. Blackburn*

Red rain, representing sediment from duststorms, was recorded in southern Victoria on many occasions from 1896 to 1945. The early falls prompted contributions in several publications, including the *Victorian Naturalist*. This interest in Australian red rain can be related to the more or less contemporary enquiries in the northern hemisphere about the nature and origin of red rain and related falls of dust, especially those in Italy. A review of available records shows that serious droughts have been associated with most falls of red rain in Victoria, but there are indications that some droughts have passed without such incidents. An absence of red rain during the current period of severe drought in south eastern Australia would imply either a lack of strong winds and rain or the effect of soil conservation measures in farming areas. Occasionally, as on 16 February 1983, a duststorm descends on Melbourne but red rain is not recorded.

Falls of atmospheric dust in different countries are sometimes accompanied by coloured rain, with red as the most common variety because of its association with sirocco dust and repeated occurrence in southern Italy (Free 1911). The nature and origin of the sediment attracted attention in the 19th century, with particularly detailed attention by C. G. Ehrenberg, a founder of micropalaeontology, who also examined the shipboard samples of brown dust collected by Darwin and Lyell during voyages in the Atlantic Ocean (Darwin 1860).

The first Australian contributions on red rain show the influence of the European observations and theories. Thus Phipson (1901a) favoured a cosmic source for the Victorian material on account of its content of iron and nickel, while Brittlebank (1896) and Chapman and Grayson (1903) followed Ehrenberg in reporting diatoms in red rain. Exotic theories for the origin of red rain in Victoria were soon dropped and inland Australia was seen as the source of this rain and of similar falls recorded in New Zealand (Gregory 1912), just as the Sahara became the acknowledged source of red rain in Italy.

Chemical analyses of red rain showed the predominance of silica, iron oxide and alumina (Steel 1898, Phipson 1901b). The mineralogy of sediment from red rain was given in detail by Chapman and Grayson (1903), showing quartz, feldspar, limonite, and augite as the most common minerals. Anderson (1941) found one unusual feature of the red rain. Rain collected at Kew from southerly winds (from the ocean) almost invariably had an appreciable content of chloride, but that from northerly winds had very little — except for the red rain, whose chloride content was comparable to that of rains from the ocean.

Chapman and Grayson (1903) reported a variety of organic materials in red rain, including pollen, vegetable tissue, sponge spicules, siliceous material from grasses and sedges, and diatoms — the siliceous tests of freshwater algae present in swamps and soils. They listed more than 24 species of diatoms, although together these represented less than 1% of the particles. These authors nominated the swamps and lakes near the Murray River as the probable source of the diatoms, an opinion later presented as fact by Gregory (1930) in dealing with the Australian source of red rain falling in New Zealand. However, it had been suggested earlier (Shephard 1896) that the

* Division of Soils, CSIRO, Glen Osmond, South Australia, 5064.

**Table 1.** Falls of Red Rain in and near Melbourne and Associated Serious Droughts in Victoria, South Australia, and New South Wales.

| Date | Reference | Related 'most intense' droughts (Foley, 1957) | | | |
|---|---|---|---|---|---|
| | | Victoria | S.A. | Inland N.S.W. | Major Aust. Droughts |
| 12 Dec 1896 | 1 | | | | |
| 26 Dec 1896 | 2 | | 1895/98 | | |
| 27 Dec 1896 | 3,4,5 | 1895/1902 | | 1895/1903 | 1895/1903 |
| 14 Feb 1903 | 5,6,7 | | 1901/03 | | |
| 28 March 1903 | 6,7 | | | | |
| 3 Nov 1920 | 8 | 1918/20 | 1918/20 | 1918/20 | 1918/20 |
| 23 Dec 1922 | 9 | | 1921/30 | 1921/30 | |
| 11 Oct 1925 | 9 | 1925/30 | 1921/30 | | |
| 31 Dec 1927 | 9 | 1925/30 | 1921/30 | 1926/30 | |
| 2 Aug 1929 | 9 | | | | |
| 30 Aug 1929 | 9 | | | | |
| 8 Oct 1929 | 9 | 1925/30 | 1921/30 | 1926/30 | |
| 26 Dec 1929 | 9 | | | | |
| 24 Oct 1933 | 9 | | 1931/36 | 1933 | |
| 19 Sept 1934 | 9 | | | | |
| 19 Dec 1934 | 9 | | 1931/36 | | |
| 9 Jan 1935 | 9 | | | | |
| 9 Oct 1935 | 9 | | | | |
| 27 Oct 1935 | 9 | | 1931/36 | | |
| 10 Dec 1935 | 9 | | | | |
| — Sept 1937 | 10 | 1937/39 | | 1937/39 | |
| — April 1938 | 7,10 | 1937/39 | | 1937/39 | |
| — — 1944 | 8 | 1944 | 1944 | 1943/45 | 1939/45 |

Key
1 Phipson (1901a)
2 Phipson (1901b)
3 Brittlebank (1897)
4 Steel (1898)
5 C.M.B. (1911)
6 Chapman and Grayson (1903)
7 Baker (1959)
8 Anon (1945)
9 C.M.B. (1937)
10 Anderson (1941)

diatoms in red rain were found commonly in Victoria and would give no clue as to the origin of the dust. Brewer (1955) provided some confirmation on this point with his evidence on diatoms in soils of New South Wales; Leeper (1955) pointed out that five of Brewer's (seven) genera were also among those reported by Chapman and Grayson (1903).

Phytoliths, the siliceous remains of plants, may be an important constituent of red rain. According to Baker (1960), these plant remains were first described in Europe by Ehrenberg from a variety of sediments including red rain. In Victoria they were sometimes confused with sponge spicules (Baker 1959). Particle counts by Baker (1959) of residue from the red rain examined by Chapman and Grayson (1903) showed that phytoliths were slightly more numerous than diatoms and sponge spicules were rare.

Residues from further falls of red rain may provide additional information, as only a few samples collected in 1896, 1903, and 1938 have been examined in any detail. All existing information, however, suggests that a definite source area for the red rain is unlikely to be indicated by intrinsic features of the red rain residue.

**Red Rain and Droughts**

Information on falls of red rain in and near Melbourne is due mainly to the Bureau of Meteorology, whose published records to the end of 1935 are used in Table 1. Of the four falls listed from other sources to 1935, two appear to have involved some confusion by Phipson (1901a,b), one seems to be a definite omission by the Bureau, and the fourth (November 1920) may also be an omission by the Bureau.

Foley (1957) gives the duration of the most intense droughts in different States; the relation of these droughts to falls of red rain is shown in Table 1. The rain can be related to periods of intense drought affecting Victoria, South Australia, or New South Wales, but it is remarkable that there is no record of red rain at the time of the major Australian drought in 1914. This anomaly may be due to an omission from the records of the Bureau of Meteorology, but it may be explained by lack of strong winds during that drought. The lack of good records for red rains since about 1944 is tantalising in regard to the widespread drought of 1967/68, which nevertheless must have been windy enough to account for the reddish dust sampled from snow in the Mt. Kosciusko area in November 1968 by Walker and Costin (1971).

It is unfortunate that details of the red rains in 1938 are not readily available, because Loewe (1943) conveniently detailed the meteorological conditions associated with duststorms reaching Melbourne in early, mid-, and late April of that year.

The information provided in Table 1 indicates that the source area for red rain before the 1930's can only be defined as south eastern Australia. Those which occurred in the early 1930's appear to incriminate South Australia, then affected by droughts, and those in 1937 and 1938 probably had their source in Victoria. The frequency of red rain during 1929–35 may be connected with an emphasis on bare fallowing in the drier agricultural areas or overstocking in pastoral areas.

Generally the records for red rain in Melbourne suggest that there was a peak frequency in the 1920's and 1930's, but the point may remain in doubt unless good records are found for the period since 1935. If records of red rain in Melbourne are kept in future, it may be possible to find the relative importance of different factors involved:- drought severity and extent, wind conditions, and farming practices.

REFERENCES
Anderson, V. G. (1941). The origin of the dissolved inorganic solids in natural waters with special reference to the O'Shannassy River catchment, Victoria. *J. & Proc. Aust. Chem. Inst. 8:* 130-50.
Anon. (1945). Symposium on 'red rain'. *Vict. Nat. 61:* 165-68.
Baker, G. (1959). Opal phytoliths in some Victorian soils and 'red rain' residues. *Aust. J. Bot. 7:* 64-87.
Baker, G. (1960). Phytolitharien. *Aust. J. Sci. 22:* 392-3.
Brittlebank, C. C. (1897). Natural history note. *Vict. Nat. 13:* 125.
Brewer, R. (1955). The occurrence of diatom skeletons and sponge spicules in the soils of New South Wales. *Aust. J. Sci. 17:* 177-79.
Chapman, F., and Grayson, H. J. (1903). On 'red rain', with special reference to its occurrence in Victoria. With a note on Melbourne dust. *Vict. Nat. 20:* 17-32.
Commonwealth Bureau of Meteorology (1911). Results of rainfall observations made in Victoria during 1840-1910. (Govt. Printer; Melbourne).
Commonwealth Bureau of Meteorology (1937). Results of rainfall observations made in Victoria (Supplementary volume). (Govt. Printer; Melbourne).
Darwin, C. (1860). "Journal of researches into the natural history and geology of the countries visited during the voyage of H.M.S. Beagle round the world", etc. 3rd Ed. Copy 'The voyage of the Beagle'. (J. M. Dent; London).
Foley, J. (1957). Droughts in Australia. Review of records from the earliest years of settlement to 1955. Bull. Commonw. Bur. Met. No. 43.
Free, E. E. (1911). The movement of soil material by the wind, with a bibliography of eolian geology. *U.S. Dept. Agric. Bureau of Soils Bull. No. 68.*
Gregory, J. W. (1912). 'The geography of Victoria'. 2nd Ed. (Whitcombe and Tombs; Melbourne).
Gregory, J. W. (1930). Australian origin of red rain in New Zealand. *Nature 125:* 410-11.
Kidson, E. (1930). Australian origin of red rain in New Zealand. *Nature 125:* 410.
Leeper, G. W. (1955). Diatom skeletons and sponge spicules. *Aust. J. Sci. 18:* 59-60.
Loewe, F. (1943). Duststorms in Australia. *Bull. Commonw. Bur. Met. No. 28.*
Phipson, T. L. (1901a). Composition and nature of the red rain. *Chem. News. 83:* 159-60.
Phipson, T. L. (1901b). Analysis of the red rain deposit which fell in Victoria, Australia, on December 26, 1896 and which is similar in appearance to that which fell in Italy in March 1813 and again in March of the present year. (Second note). *Chem. News 83:* 253.
Shephard, J. (1897). Natural history note. *Vict. Nat. 13:* 125-6.
Steel, T. (1898). On 'red rain' dust. Rept. 7th meeting Australasian Assocn. Advancement of Sci., pp. 334-5.
Walker, P. H. and Costin, A. B. (1971). Atmospheric dust accession in south-eastern Australia. *Aust. J. Soil Res. 9:* 1-5.

---

## *Naturalist Review*

### "Nature's Night Life"

BY ROBERT BURTON

1982 Blandford Press, Dorset, U.K. Distributed in Australia by ANZ Book Co. ISBN 0 7137 11116. Rrp $17.95. 160 pp.

This is a natural history book with a rather unusual approach. Its aim is to examine aspects of the nocturnal world on a habitat by habitat basis. It is not, as the dustjacket assures us, just "a catalogue of nocturnal animals, but a fascinating discussion of night life in the wild, illustrated by specific examples from all over the world". Although some might argue that therein lies its major weakness (in under 200 pages it tries to cover the natural history of so many different animal groups in so many different habitats), I feel the book is still sufficiently interesting and certainly covers many and diverse topics so that few readers would find it boring.

The book is well illustrated with 63 colour and 57 black and white photographs. Many of these are excellent, including a hippos' wallow, a snoozing leopard and a cute fennec; other photographs are rather poor — for example, that of the Echidna. Australian fauna is sadly neglected — the Numbat, Echidna and four gliding possums (there are five) are only mentioned in passing, while the only other reference to our animals occurs in the following except taken from the chapter on "Deserts".

> "The natural history of Australia and its strange collection of marsupial mammals must not be overlooked here. In the middle of this huge continental island there is an extensive

area of desert and semi-desert, which is inhabited by a number of animals. Most marsupials are nocturnal, the wombat being one exception (sic), so their daily regime suits them for a desert life. As well as the small mulgara, the dunnart or pouched mouse, and the jerboa marsupial, some of the largest kangaroos are to be found in dry places. The red kangaroo or euro rest during the day, the wallaroo sometimes sheltering in caves, and they graze or browse at night".

Surely a better treatment of Australian arid-adapted fauna is possible? No mention of *Notomys alexis* — the rodent which produces the most concentrated urine of any mammal? What of our desert frogs which survive years underground in their skin-shed cocoons?

Nevertheless the book does have many good features: it is written in a generally entertaining style, is well illustrated and when on more familiar territory (e.g. the African Savannah), the text is more authoritative.

**R. Wallis**

---

## *Victoria Archaeological Survey*
## *Summer Field Program*
### DECEMBER — JANUARY 83/84

Members of the public are invited to participate in the Victoria Archaeological Survey Summer Field Program. Next season work will be conducted at two sites, Corinella on Westernport Bay and Gairdner's Cottage.

#### CORINELLA
5.12.83 — 23.12.83; 3.1.84 — 22.1.84 (6 weeks duration)

Corinella was the site of the second official settlement in the Port Phillip Bay area. Lasting only 18 months, the settlement consisted of several brick buildings and other associated features such as brickworks and saw pits. The principal source of labour used were convicts. After its abandonment in 1829 the buildings suffered from natural decay and from the attention of subsequent settlers who used the remaining bricks for their farm buildings. Today the exact location of the site remains unknown. The aim of the archaeological project has been to exactly locate the remains of the early settlement at Corinella, (details of the history of the site are shortly to be published in the VAS records series).

The next seasons work will continue the excavations of last year. Around 15 volunteer positions are available each week as well as 3 positions for field supervisors (Professional Archaeologists). Subsidies for food and a limited amount of accommodation may be available.

#### GAIRDNER'S COTTAGE
3.1.1984 — 22.1.1984

This building is located on the south coast of French Island and dates at least from the 1850's. It is the oldest structure on French Island and contains one of the few genuine wattle and daub structures in Victoria. The original wattle and daub structure is surrounded by later additions and as a whole the building is decaying. Work this year will involve detailed recording of the site and some excavations. Around 4 volunteer positions are available each week as well as 1 position as Assistant Director. Subsidies for food and a limited amount of accommodation may be available.

Applications for both the paid and volunteer positions should be forwarded to:

The Director,
Victoria Archaeological Survey,
29–31 Victoria Avenue,
ALBERT PARK, Vic. 3206

Telephone enquiries to Iain Stuart (03) 690 5322

Closing date is the 11.11.83, but the VAS reserves the right to make appointments at any time.

# Field Naturalists Club of Victoria

## Reports of recent activities

### General Meeting
### Monday 21 March

**The speaker** was Dr Pat Rich from Monash University. Dr Rich spoke of fossil birds and her search for reasons for the uniqueness of Australian fauna. Some Australian birds such as lyrebirds and the magpie group have few relatives outside this country but others are related to old world birds. How has this occurred?

Fossil records of birds go back about 130 million years, but some 60 million years ago Australia was joined to Antarctica (at that time mostly ice-free and forested), and Antarctica was probably connected to South America by a string of islands. Hence there could have been movement of fauna between South America and Australia. About 20 million years ago Australia approached its present position. It is surmised that the particularly Australian birds such as emus and magpies originated in South America, while bustards and sundry passerine birds entered Australia from the old world after Australia's move northward; others may have come across the sea.

Dr Rich spoke of her researches in Central Australia and fossil finds near Alice Springs of *Dromornis*, a huge flightless bird that existed some 20 million years ago. It looked like an outsize emu but was related to barnyard fowls, rather than to emus. There is speculation about what this 3 metre tall creature lived on as the fossil jaws indicate it was not a carnivore. Also in Central Australia are fossils of flamingo-like birds. This is our best area for fossils but finds are small compared to other countries and, as everywhere, aggravated by the fragility of bird bones.

**Conservation.** Following its special report on the Alpine National Park, the LCC has received many submissions from grazing interests but few from conservationists. Also legislation is proposed that would give the Ski Resorts Commission authority to declare a ski resort on any crown land including national parks; members are urged to write and protest to their parliamentary member and to the Minister of Tourism.

**Exhibits.** Microscopes of the late Dr R. M. Wishart displayed some of his slides; the microscopes with accessories, two slide cabinets with 654 slides and sundry books and journals were given to this Club by his daughter Mrs Alison Mittag, and a letter of thanks will be sent to her; this donation formed the main exhibit.

An ichneumon wasp was shown under a low-power microscope. Green scum from Ricketts Point beach use in a bowl and part of it under X100 microscope revealed it to consist of swimming single-celled organisms *Euglena*. Three caterpillars of the Banksia Moth, each about 5cm long (2"), dark brown with large white spots and a squarish head, had proved voracious eaters, doubling their size each day.

The Mammal Survey Group reported netting seven bat species at their Torbreck River camp.

### General Meeting
### Monday 14 April

**Honorary Membership** was conferred on Mrs Florence R. Vasey who recently completed 40 years in the Club.

**Speaker** for the evening was Dr Peter Jell on the evolutionary history of the Echinodermata. Dr Jell opened by showing photos of some living members of the phyllum — sea stars, holothurians (sea cucumbers), sea urchins, feather stars and sea lilies. They are all radially symmetrical and have hard external or internal limy plates. There is debate

about the origin of the echinodermata and Dr Jell dates his new re-grouping of the phyllum from primitive Eocrinoids which probably originated in Pre-Cambrian times — about 600 million years ago. He showed photos and drawings of early fossil forms and not-so-early, but even the latter were hard for layman to relate to the creatures we know.

**Conservation.** Concerning the hoped for Alpine National Park: the LCC has received only 600 conservation submissions among 1400 so it's likely that the LCC recommendations will be less favourable to conservation interests; members are urged to write to LCC as soon as those recommendations are published — even if the writer can only say that he wants the Alpine reserves linked into one large Park with exclusion of grazing and logging.

**Exhibits & Nature Notes.** Under a microscope were shown the wheel-like limy ossicles in the skin of a sea cucumber, another showed decoratively arranged anchor and plate ossicles of a different sea cucumber, and a third showed cross sections of the spines of a sea urchin.

A spider, about half centimetre long with legs twice that length, was identified as a very young huntsman, probably genus *Isopoda.* The shell of a fan mussel *Atrina tasmanica* found at King Island was about 20cm long (8″) and 13cm (5″) at its widest part, somewhat translucent, very fragile and brittle.

Photos showed a bat trap used by the Mammal Survey Group, and rock fossickers during the marine excursion in February and the afternoon fog that cut visibility down to about three metres.

A member reported a gecko in his Seaford bathroom one evening but it did not return. Another reported on the drought in the Grampians where many eucalypts have died, also some wattles and banksias. Similar drought effects were reported about Castlemaine where Red Stringybark is the main victim. Another said that fewer animals have been trapped by the Mammal Survey Group than in previous years. But one member reported 27 emus in one paddock near the Grampians.

A member spent 2½ weeks travelling down the Franklin River, trapped numerous animals but no bats, saw very many platypus and recorded 40 different birds.

### Annual General Meeting
### Monday 9 May

**Annual Report for 1982** was read by President Miss Wendy Clark. The main points were:

Some progress has been made in three of the four objectives announced at the beginning of the year: (i) a more active role in conservation has been achieved by our conservation committee with submissions on many issues; (ii) member participation at meetings has increased with more exhibits and nature notes; (iii) outside awareness of the Club seems to have increased; but (iv) search for new Club premises has lapsed due to other work but is still considered important.

Honorary memberships was awarded to five people who had completed 40 years membership.

General excursions and Group excursions continued with the five active study groups — Botany, Day, Geology, Mammal Survey and Microscopic Groups.

1982 Australian Natural History Medallion was presented posthumously to Mr Howard Jarman for his work on birds.

Special appreciation was expressed for the work of our secretary Mrs Sheila Houghton.

**Treasurer's Report for 1982.** Financial statements were printed in full in the March/April Naturalist.

Treasurer Mr David Dunn reported that prompt payment of subscriptions,

increased sales of back Victorian Naturalists and increased interest on investments enabled the Club to keep slightly ahead of inflation with a surplus for the year of $136.00.

**Election of Officers and Council Members.** Officers elected: President Miss Wendy Clark, Secretary Mrs Sheila Houghton, Treasurer Mr David Dunn, Assistant Treasurer Mr Geoff Sargeant, Editor Mr Robert Wallis, Librarian Mrs Jane Calder, Excursion Secretary Miss Marie Allender, Programme Secretary Miss Cathy Zerbe. Offices vacant: Vice-President, Assistant-Secretary, Assistant-Editor, Assistant-Librarian.

Council Members elected: M.Allender, D.Dunn, I.Faithful, S.Houghton, M.Potter, G.Sargeant, C.Shankly, H.Stanford, H.Weatherhead, plus the President (W.Clark).

Other appointments: Minute Secretaries A.Walker and T.Sault, Conservation Co-ordinator M.Turner.

**Speaker** for the evening was Miss Wendy Clark on "Eat or be eaten". Miss Clark stressed the importance of small creatures and plants in the ecology of forests and other natural environments. Colour slides were shown of various "creepy crawlies" such as millipedes, flat worms, flies and of small plants such as mosses and fungi.

**Conservation.** Mr Malcolm Turner reported the Club's efforts in protest against the Franklin dam with letters, telegrams and money. The conservation committee made written submissions to the LCC on the Alpine Study Area, Gippsland Lakes Hinterland Study Area and on Gippsland Lakes Hinterland Proposed Recommendations, Hill End Study Area and then on the Proposed Recommendations, South-West District 1 Proposed Recommendations. Submissions to other bodies concerned the proposed Alpine Resorts Commission and the proposed subdivision of the Melton Mallee. The Club also expressed views on logging in the Otway National Park and on the proposed Grampians National Park. As well as preparing these submissions members of the conservation committee represent the Club's views at the Conservation Council of Victoria. (Members of the committee are J.Grusavin, J.Scott and M.Turner).

**Exhibits** were plentiful. There were four containers of soil samples with their pH level and methods of finding the pH. Under a microscope were hydroids from Pt Leo. Another four microscopes displayed 4 species of gall wasps mounted by Mr John Strong and donated by him to the Club.

A blue/grey/green caterpillar, length about 4cm (1⅝") with 4mm yellow spines was the larva of Hercules Moth *Coscinocera hercules*, world's largest moth with wing span up to 27cm (10½"); the larva can grow to 15cm (6"), was found in Queensland and is feeding now on Privet. The 2cm (⅞") larva of a casemoth *Narycia* sp had a case made of sand grains. Another caterpillar, larva of the moth *Plusia pseudochalcytes*, pale green about 3cm long (1¼") was feeding on a tomato plant.

The shell of Granulated Tasmanian Snail *Anoglypta launcestonensis* was about 2.5cm across (1"), circular and flattish, and shell of Tasmanian Freshwater Limpet *Anclyastrum cunningianus* was about 1cm; the latter is now rare due to the introduction of trout to Tasmanian streams.

There were several fungus specimens, the most remarkable being a huge *Boletus* from near Dromana — diameter more than 70cm (2ft), the stalk about 20cm across and 25cm long (10"), all a dark chocolate colour and soft.

An active dark green frog "Pobblebonk" was about 8cm long (3") and quite stout.

(Continued from Inside Front Cover)

## GROUP EXCURSIONS

All FNCV members are invited to attend Group excursions

**Botany Group.**
Saturday, 23rd July. To be announced.
Saturday, 27th August. "The 100 acres".

**Mammal Survey.**
June 11-13 — Camp to Lower Tonbreck River.
July 9-10 — Camp to Taronga River. Leadbeater Possum Survey.
August 13-14 — Camp to Big River.

# *Field Naturalists Club of Victoria*

Established 1880

Registered Office: FNCV, c/- National Herbarium, Birdwood Avenue, South Yarra, 3141.

**OBJECTS:** To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

*Patron:*
His Excellency Rear Admiral SIR BRIAN S. MURRAY, KCMG, AO.

**Key Office-Bearers 1983-1984**

*President*
Miss WENDY CLARK, 27 Rangeview Grove, North Balwyn, 3104 (859 8091 A.H.)
*Vice-President:*
*Hon. Secretary:* Mrs SHEILA HOUGHTON, 30 Golf Links Crescent, Dingley, 3172 (551 2708 A.H.)
*Hon. Treasurer:* Mr DAVID DUNN, 3 Allfrey Street, East Brighton, 3187 (578 5753)
*Subscription-Secretary:* Miss H. MALCOLM, c/- FNCV National Herbarium, Birdwood Avenue, South Yarra, 3141
*Editorial Material:* Forward to Dr B. SMITH, National Museum of Vic., Russell St., Melbourne, 3000
*Librarian:* Mrs JANE CALDER, c/- FNCV National Herbarium, Birdwood Avenue, South Yarra, 3141
*Excursion Secretary:* Miss MARIE ALLENDER, 19 Hawthorn Avenue, Caulfield, 3161 (527 2749)
*Book Sales Officer:* Mr D. L. McINNES, 129 Waverley Road, East Malvern, 3145 (211 2427)

**Group Secretaries**

*Botany:* Mr PETER CARWARDINE, 2a Victoria Road, Malvern, 3144 (509 0622 B.H. 211 8958 A.H.)
*Day Group:* Mrs E. L. GILLESPIE, 23 Wild Cherry Road, Carnegie 3163 (578 1879)
*Geology:* Mr TOM SAULT, c/- FNCV, National Herbarium, Birdwood Avenue, South Yarra, 3141
*Mammal Survey:* Mr LANCE WILLIAMS, 29 Erica Crescent, Heathmont, 3135 (879 1962 A.H.)
*Microscopical:* Mrs ELSIE GRAHAM, 147 Broadway, Reservoir, 3073 (469 2509)

**MEMBERSHIP**

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

**Subscription rates for 1983**

| | |
|---|---|
| Metropolitan | $15.00 |
| Joint Metropolitan | $18.00 |
| Country Members and Retired Persons | $12.00 |
| Joint Country and Joint Retired | $15.00 |
| Junior | $3.00 |
| Subscription to Victorian Naturalist | $13.00 |
| Overseas Subscription to Victorian Naturalist | $15.00 |
| Individual Journals | $2.20 |

All subscriptions should be made payable to the Field Naturalist Club of Victoria and posted to the Subscription Secretary

Jenkin Buxton Printers Pty. Ltd. 113 ABBOTSFORD ST WEST MELBOURNE 328 4774 329 7959

# The Victorian Naturalist

Vol. 100, No. 4
July/August
1983

Published by the FIELD NATURALISTS CLUB OF VICTORIA
in which is incorporated the Microscopical Society of Victoria

Registered by Australia Post - Publication No. V.B.P. 1268

$2.20

## FNCV DIARY OF COMING EVENTS

# GENERAL MEETINGS

**Monday, 8th August, 8.00 p.m.**

Launching by Mrs Ellen Lyndon of Mr Cliff Beauglehole's publication "Distribution and Conservation of Vascular Plants in the Melbourne Study Area." Mr Beauglehole will then speak on this subject.

**Monday, 12th September, 8.00 p.m.**

Bushfires: Recovery and regeneration, by FNCV groups.

**Monday, 10th October, 8.00 p.m.**

Mr Donald Johnson, Bird Life of Iowa.

**New Members — July/August General Meetings.**

*Metropolitan*

June Brack, 165 Gordon St., Balwyn (botany)
K. Dunn; 16 Grace Ave., Dandenong
Peter Falconer, 11 San Martin Dr., Croydon (sub-alpine & wet sclerophyll ecology)
Peter Hands, Ormond College, Univ. of Melbourne, Parkville (birds)
Myra Roche, 1/6 Davidson St., Sth. Yarra

*Country*

Bernadette Hoey, 17 Kiaora Ave., Mt Martha (mammals)
Graeme Suckling, Forests Commission, Mountain Forest Research Station, Sherbrooke (mammals)

*Joint*

Les Wessely, C/- Loch Sport P.O., Loch Sport
J. & L. Burns, 2 Lansell Crt., Toorak

# FNCV EXCURSIONS

**Sunday, 7th August.** Queenscliff. The coach will leave Batman Avenue at 9.30 a.m. Fare $9.00. Bring a picnic lunch.

**Sunday, 4th September.** Botanic Gardens annexe at Cranbourne. The coach will leave Batman Avenue at 9.30 a.m. Bring a picnic lunch.

**Friday evening, 2nd September — Sunday, 4th September.** Campout at Cathedral Range State Park with John Milligan and Dr Jim Willis. Contact John Milligan on 557 3509 (A.H.) if you intend going. Details in last Naturalist.

**Friday, 16th September — Saturday, 1st October.** Lord Howe and Norfolk Islands. Waiting list only, details in last Naturalist.

**Sunday, 2nd October.** Blackburn Lake. Leader: Mrs Jean Zirkler. Take train which arrives at Blackburn Station at 11.13 a.m. Proceed along Central Road, past Morton Park to Lake Road and meet at Lake Street entrance at approximately 11.30 a.m. Bring lunch. It would be appreciated if members going by car could meet at the station and offer those going by train a lift to Blackburn Lake.

**Saturday — Sunday 8 — 9th October.** Ocean Grove. This is the Spring get-together of the V.F.N.C.A., and the Geelong F.N.C. will be hosts for the weekend. There will be excursions on Saturday and Sunday, one to see the regeneration after the fires and the other to an area where there is a possibility of seeing the Orange-breasted Parrot. On Saturday night a meeting will be held. These weekends are most enjoyable so come if you can. This weekend will be based at the Ocean Grove Motel and Caravan Park, 64 Wallington Road. A coach has been chartered and accommodation B. and L.B. booked at the motel at a cost of $48 for the weekend. This should be paid to the excursion secretary by 1st September. The coach will leave Flinders Street from near the Gas and Fuel Corporation at 8.00 a.m. Saturday. Bring picnic lunches for Saturday and Sunday. Caravan and tent sites are available and should be booked direct, phone (052) 55 1255. There may be accommodation booked above the needs of the coach party so if anyone is going by car and wishes to stay in the motel they should contact Miss M. Allender, 19 Hawthorn Avenue, Caulfield North, 3161 phone 527 2749.

**Sunday, 6th November.** Labertouche. The club picnic will be held on Sunday this year as many members have other commitments on Cup Day.

**Thursday, 12th to Thursday 19th January.** King Island. The group will fly to Currie on Thursday morning where they will stay for the week at the Boomerang Motel on a R.O. basis. Cost for airfare and accommodation is $300. A deposit of $50 should be paid when booking. Further details in next Naturalist.

# GROUP EXCURSIONS

All FNCV members are invited to attend Group excursions.

**Botany Group.**

Saturday, 27th August. The 100 acres reserve, Park Orchards.

Saturday, 24th September. Courtney's Road, Belgrave South.

Saturday, 29th October. East Metcalf — Black Hill, Kyneton.

**Mammal Survey Group**

August 13th-14th. Camp at Big River.
September 22nd-25th — Camp at Gunbower.
October 8th-9th. Camp at Strathbogie Ranges.

(Continued on inside back cover).


# The Victorian Naturalist

Volume 100, Number 4

July/August, 1983
ISSN 0042-5184





*Cover illustration* — Glass-eels, an early stage in the life cycle of eels. See article page 168.

# The Distribution, Ecology and Conservation Status of *Acacia suaveolens*

By David Morrison*, Tony Auld*, and Kerri Gallagher*

**Introduction**

*Acacia suaveolens* (Sm.) Willd. is a small coastal wattle endemic to eastern Australia. It certainly cannot be considered to be an endangered species, as it is widespread and fairly common and many large populations have been incorporated into conservation areas. However, there is cause for concern in some geographical areas, as the former distribution of the species was apparently much larger than it currently appears to be, particularly in Qld., Vic. and Tas. To quote Specht (1981b): "before long, even the most common plants may be included in the list of 'plants at risk' ".

Consequently, it seems desirable to review the distribution, ecology and conservation status of this species, in order to clarify the situation as it currently stands. In this paper we therefore discuss the published literature in relation to our own knowledge acquired over the last four years. Pointing out known inaccuracies in the literature is an important function of modern publications, as references are often made to the literature without any critical assessment of their accuracy.

**Distribution**

Despite the fact that the plants are rather straggly, they grow quickly to 2–3 m high, and are easily visible for much of their lifetime against the background of slower-growing plants. As well, the pods are quite conspicuous, and, as Galbraith (1960) points out, are often more noticeable than the flowers. As a result, *A. suaveolens* has a long history of collection as herbarium specimens, being first collected by Banks and Solander at Botany Bay in 1770 (Banks & Solander, 1900), and then again by Labillardière at Storm Bay (in Tas.) in 1792 (Labillardière, 1807).

The data presented in Fig. 1 came originally from locality data taken from the labels of herbarium specimens lodged with the state herbaria of Qld., N.S.W., Vic., S.A. and Tas., and also from the Herbarium Australiense, the Canberra Botanic Gardens and the University of Sydney's John Ray Herbarium. The map was then completed during two field trips: in November 1980 from Sydney to Marlborough in Qld., and in November 1981 from Sydney to Adelaide. These field trips filled in many of the gaps in the distribution, and extended the known northern boundary by 80 km.

The Tasmanian distribution shown on the map is from the herbaria labels only, and is thus presumably incomplete. Harvey (1974) cites *A. suaveolens* as being common in Tas.; but as we haven't personally studied any of the Tasmanian populations, we won't discuss them further.

The published accounts of the mainland distribution are in most cases incomplete, and in many cases are incorrect. Most authors, however, correctly cite the occurrence of *A. suaveolens* in the restricted areas they are dealing with. The major exception is Willis (1972), who excludes the coastal populations between Lorne and Cape Otway, and adds populations on the Victorian coast east of the South Australian border. These latter records are also considered by Beauglehole (1980) to be erroneous. Also, Galbraith (1967) seems to imply that populations occur throughout Vic., except in the north-

* School of Biological Sciences, University of Sydney, N.S.W. 2006.

west; Baglin & Mullins (1976) imply that they occur throughout the Tablelands of N.S.W.; Scarth-Johnson (1968) excludes them from these very same Tablelands; and Simmons (1981) suggests that they are found throughout the Great Dividing Range.

Most authors also correctly cite the occurrence of the species in the other states. However, Hodgson & Paine (1971), Galbraith (1977), Harris (1979) and Blomberry (1980) specifically exclude S.A.; Blomberry (1980) also excludes Qld.; and Curtis (1956) claims that it occurs throughout temperate Australia.

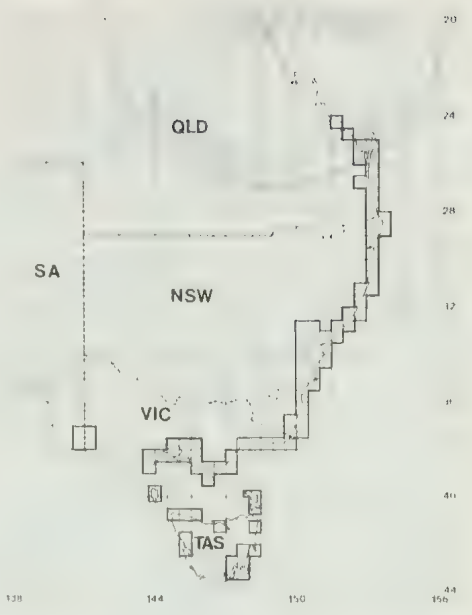



Fig. 1. Known distribution of *Acacia suaveolens* on a standard ½° × ½° grid, the dark line outlining grids from which populations have been recorded.

**Environmental Correlations**

The principal environmental factor correlating with the distribution of *A. suaveolens* is soil type. Baglin & Mullins (1976), Harris (1979) and Beadle *et al.* (1982) describe the species as growing on sandstone, while Curtis (1956), Galbraith (1960, 1977), Scarth-Johnson (1968), Harvey (1974), Beadle (1976), Pedley (1979), Whibley (1980) and Simmons (1981) all suggest that it grows on sandy soils. We have found that populations throughout the distribution are restricted to these two types of soil. Baglin & Mullins (1976), Pedley (1979) and Whibley (1980) all emphasise that these soil types are extremely infertile.

Throughout most of the distributional range, populations are virtually restricted to Quaternary sands, not really extending more than a few kilometres inland. The only areas where inland incursions occur are on sandstones: Jurassic sandstones in the McPherson Range (near the Qld.-N.S.W. border), Triassic sandstones in the Blue Mountains (near Sydney), Devonian sandstones in the Budawang Range (near the N.S.W. south coast) and Ordovician sandstones inland of Orbost (on the Victorian east coast).

The northern boundary of the distribution is near the border of the lime-free sandy and sandy-loam soils (which are the dominant soil types along the eastern Australian coast) and the lime-rich black earth clays and clay-loams (which form much of the coastal soils north of Marlborough). The large disjunction in western Vic. is caused by the Tertiary limestones and Quaternary volcanics of the western Victorian coastline.

The second large-scale environmental correlation appears to be with the Great Dividing Range. The only places where populations occur in higher altitudes (McPherson Range, Sydney Basin, Budawang Range, near Orbost) is where the sandstone soils are contiguous with the sandy coastal plain. In other areas, the higher sandstone outcrops which are isolated from the coast don't support populations. The inland thrust in western Vic. coincides with the western limit of the Range.

**Morphological Forms**

Two restricted morphological forms

of *A. suaveolens* also exist. Around Sydney, a form with a prostrate, spreading habit, and much broader phyllodes than the usual form, is often found on exposed headlands. This is possibly a phenotypic response to strong winds. The other unusual form is found in the Myall Lakes area north of Sydney. This form has very narrow phyllodes (less than 2 mm wide; Armitage, 1977), and is common in the sandy woodlands. This appears to be a distinct genotype within the species.

**Habitat**

The habitat of *A. suaveolens* is restricted to heaths and woodlands (as defined by Beadle & Costin, 1952), and it is usually excluded from the other common coastal vegetation types, such as dense scrub, dry sclerophyll forest, wet sclerophyll forest, rainforest and swampland. For example, a fairly large discontinuity in the distribution occurs along the Victorian coast near Seaspray, apparently due to dense coastal scrub with extensive swamps further inland. Thus, despite the sandy coastal soil, no *A. suaveolens* populations have been found in this area. Interestingly, populations of *A. suaveolens* are more commonly found in heaths in the northern half of the distribution, and in woodlands in the southern half. It is usually reported from heaths in Tas. (Curtis, 1956; Harvey, 1974).

The literature is, once again, rather inconsistent regarding habitat. Various general references report the species as being only from heaths (Rotherham *et al.*, 1975; Galbraith, 1977); and the South Australian references suggest both low open-forest (Whibley, 1980) and open-forest (Specht, 1972). Scarth-Johnson (1968) says it is "often . . . an undershrub". Harris (1979) and Beadle *et al.* (1982) incorrectly assign it to dry sclerophyll forest, as well as correctly assigning it to heaths. Just to confuse things, Scarth-Johnson (1968) cites it as being from "arid places" and Hodgson & Paine (1971) cite it as from "barren and arid areas". Curtis (1956), Baglin & Mullins (1976), Galbraith (1977), Rogers (1978) and Beadle *et al.* (1982) all acknowledge it as being common within its habitat. The plants themselves, however, are only short-lived. In our experience, they live on average from 5–10 years, with a maximum of 15–20 years *(cf.* Rotherham *et al.*, 1975; Bradstock, 1981; Simmons, 1981).

**Flowering Time**

The literature also contains apparent inconsistencies concerning flowering time. Many of the references acknowledge that the flowering time is variable, and they are therefore deliberately vague. For example, references covering all of Australia suggest that flowering occurs in winter (Baglin & Mullins, 1976; Galbraith, 1977), winter-spring (Wrigley & Fagg, 1979), late winter-early spring (Harris, 1979), early spring (Hodgson & Paine, 1971) and April-September (Simmons, 1981). References dealing with N.S.W. cite March-August (Beadle, 1976; Armitage, 1977; Beadle *et al.*, 1982) and winter (Scarth-Johnson, 1968). Victorian references suggest April-October (Willis, 1972), autumn-winter (Galbraith, 1967) and June-August (Rogers, 1978). In S.A. Whibley (1980) reports May-September; and Pedley (1979) suggests May-August (but sometimes earlier) in Qld.

The key to all of this apparent confusion is given by Galbraith (1960), who points out that in warm districts flowering may begin in late February, but that full bloom is in June-July. In fact, flowering is initiated in a fairly strict geographical sequence from north to south around the coastline, beginning in late February-early March in Qld., but not until late May in western Vic. and eastern S.A. Flowering in any one population may last up to three months.

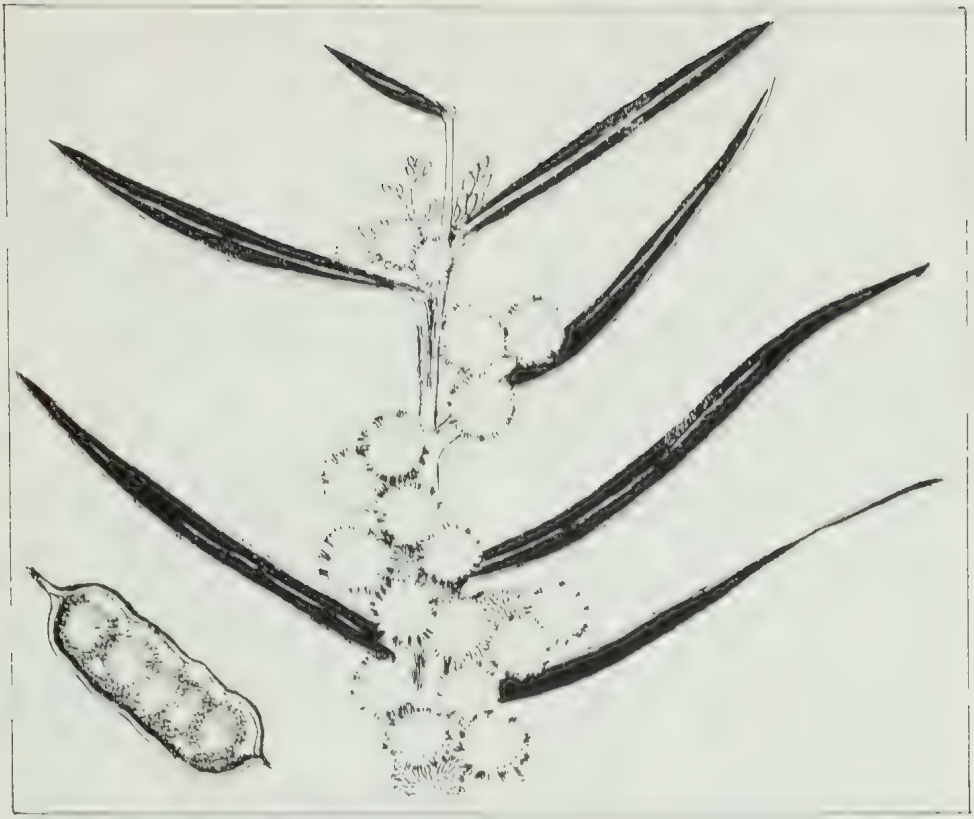


Plate 1. Sweet Wattle *(Acacia suaveolens)*

**Conservation Status**

Adamson & Fox (1982) have noted that coastal heaths in particular occur just where the Australian population and sand mining are both concentrated, and that large areas of heath in Qld., Vic., S.A. and Tas. have been cleared and developed for agriculture and pasture. Specht (1981a) points out the seeming undesirability (e.g. low soil fertility, seasonal drought or waterlogging) of the habitats occupied by heaths, yet he also lists eight competing influences which are precipitating the destruction of these habitats: pasture development, forestry, sand-mining, water conservation, recreation and tourism, urban development, transport, and fire control. Coastal heathland was the first vegetation to be affected by man (ie. sealers), and it has been reduced to a remarkable degree since then (Bowden, 1976).

Of the states in which *A. suaveolens* occurs, Qld., Vic. and Tas. do not have particularly good conservation histories for the habitats concerned (Specht *et al.*, 1974; Specht, 1981b). The effect of this situation on the occurrence of *A. suaveolens* could be clearly seen during our field trips:-

we found no substantial populations along the Victorian coast west of Sandy Point (near Wilsons Promontory), in spite of many collections in this area in the past (see Fig. 1). This appears to be a result of pastures and human settlements encroaching on the restricted habitats available along this coastline (*cf.* Bar-

son & Calder, 1981). Of particular importance in Vic. has also been the invasion of coastal heathlands by *Leptospermum laevigatum*, which is displacing disturbed heaths on sand podzols (Burrell, 1981);

a similar situation exists in Qld., where populations were not easy to find among the many new coastal housing developments north of Brisbane (see also Pedley, 1978). Where suitable habitats do occur, they are often grazed or burnt annually, and the only understorey species able to survive this treatment are perennial grasses and ferns (see also Specht, 1979). The only areas where this species appears not to be at risk are the less disturbed parts of the large sand islands such as Nth. Stradbroke, Moreton and Fraser Islands;

we were unable to locate any populations in S.A. The recorded occurrence of this species in S.A. is only relatively recent: Crocker (1944) does not mention it, but it was recorded in the later state vegetation survey (Specht, 1972). Our inquiries at the various herbaria have shown that no specimens are recorded prior to 1961, and only ten collections have been made since then. Most of these have been from vacant lots in *Pinus radiata* plantations, and so it would seem that in this state at least the species is under real threat;

in N.S.W., on the other hand, the species is very widespread and common, and can easily be located in suitable habitats, even in urban areas (in contrast to urban areas in the other states). Large representative populations are conserved in most of the coastal parks and reserves. This also applies to the two restricted morphological forms.

In Tas., although we have not specifically checked this, there has been large-scale clearing of coastal vegetation types, especially during the past thirty years (Kirkpatrick, 1977; Kirkpatrick & Dickinson, 1982). Very little of the coastal habitat has been actively conserved, and those reserves which do exist inadequately represent the range of heath communities (Specht *et al.*, 1974; Kirkpatrick, 1977; Kirkpatrick & Dickinson, 1982). It thus seems that *A. suaveolens* is less common in this state as well; and, as the clearing of coastal vegetation will presumably continue unabated (Kirkpatrick & Dickinson, 1982), this situation will continue to deteriorate.

**Conclusion**

It can be seen that *A. suaveolens* is restricted to a limited range of soil types, altitudes and habitats. While no immediate conservation threat exists, over much of the species' range suitable habitats are being destroyed, particularly at the limits of the distribution. As a result, there has been a great reduction in the abundance of *A. suaveolens*, but with little effect on the overall range to date.

However, we must not lose sight of the fact that "in the foreseeable future, many widely spread species will become restricted to a few remnants of native vegetation" (Specht *et al.*, 1974). This seems only too accurate for *A. suaveolens*, particularly in Qld., S.A. and Tas., where more conservation reserves in coastal habitats are a must if many coastal species, not just *A. suaveolens*, are to be adequately conserved.

**Acknowledgements**

We would like to thank the Directors of the National Herbaria of New South Wales and Victoria, and the Curator of the John Ray Herbarium, for allowing us to see the specimens in their care; and also the Directors of the Queensland, South Australian and Tasmanian State Herbaria, and the Canberra Botanic Gardens, as well as the Curator of the Herbarium Australiense, for sending us details of their specimens. We would also like to thank the University Research Grants to

T.A. and D.M. for the field trips; and Fred Morrison for helping with the typing.

REFERENCES

Adamson, D. A. and Fox, M. D. (1982). Change in Australasian vegetation since European settlement. In *A History of Australasian Vegetation.* (ed. J. M. B. Smith). McGraw-Hill, Sydney. pp 109–146.

Armitage, I. (1977). *Acacias of New South Wales.* NSW Region of the Society for Growing Australian Plants, Sydney.

Baglin, D. and Mullins, B. (1976). *Australian Wattles.* 2nd ed. A. H. & A. W. Reed, Sydney.

Banks, J. and Solander, D. (1900). *Illustrations of the Botany of Captain Cook's Voyage Round the World in H.M.S. Endeavour in 1768 – 71. Part I.* Trustees of the British Museum, London.

Barson, M. M., and Calder, D. M. (1981). The vegetation of the Victorian coast. *Proc. Roy. Soc. Vict. 92:* 55–65.

Beadle, N. C. W. (1976). *Students Flora of North Eastern New South Wales. Part III.* University of New England Printery, Armidale.

Beadle, N. C. W. and Costin, A. B. (1952). Ecological classification and nomenclature. *Proc. Linn. Soc. N.S.W. 77:* 61–82.

Beadle, N. C. W., Evans, O. D., and Carolin, R. C. (1982). *Flora of the Sydney Region.* 3rd ed. A. H. & A. W. Reed, Sydney.

Beauglehole, A. C. (1980). Erroneous or doubtful Victorian vascular plant grid records. *Victorian Nat. 97:* 213–216.

Blomberry, A. M. (1980). *Australian Native Plants.* 3rd ed. Angus & Robertson, Sydney.

Bowden, N. (1976). *Victorian Yearbook No. 90.* Australian Bureau of Statistics, Victoria. pp 26–29.

Bradstock, R. (1981). Our phoenix flora. *Aust. Nat. Hist. 20:* 223–226.

Burrell, J. P. (1981). Invasion of coastal heaths of Victoria by *Leptospermum laevigatum* (J. Gaertn.) F. Muell. *Aust. J. Bot. 29:* 747–764.

Crocker, R. L. (1944). Soil and vegetation relationships in the Lower South-East of South Australia. *Trans. Roy. Soc. S. Aust. 68:* 144–172.

Curtis, W. M. (1956). *The Student's Flora of Tasmania. Volume I.* Government Printer, Hobart.

Galbraith, J. (1960). Sweet wattle — *Acacia suaveolens. Victorian Nat. 77:* 131.

Galbraith, J. (1967). *Wildflowers of Victoria.* 3rd ed. Longmans, Melbourne.

Galbraith, J. (1977). *A Field Guide to the Wild Flowers of South-east Australia.* Collins, Sydney.

Harris, T. Y. (1979). *Wild Flowers of Australia.* 8th ed. Angus & Robertson, Sydney.

Harvey, N. (1974). *Wildflowers of Tasmania.* Rigby, Sydney.

Hodgson, M. and Paine, R. (1971). *A Field Guide to Australian Wildflowers. Volume I.* Rigby, Sydney.

Kirkpatrick, J. B. (1977). *The Disappearing Heath.* Tasmanian Conservation Trust, Hobart.

Kirkpatrick, J. B. and Dickinson, K. J. M. (1982) Recent destruction of natural vegetation in Tasmania. *Search 13:* 186–187.

Labillardiere, J. J. H. de (1807). *Nova Hollandiae Plantarum Specimen. Volume II.* Parisiis.

Pedley, L. (1978). A revision of *Acacia* Mill. in Queensland. *Austrobaileya 1:* 75–234.

Pedley, L. (1979). A revision of *Acacia* Mill. in Queensland (concluded). *Austrobaileya 1:* 235–337.

Rogers, F. J. C. (1978). *A Field Guide to Victorian Wattles.* 2nd ed. Brown Prior Anderson, Australia.

Rotherham, E. R., Blaxell, D. F., Briggs, B. G., and Carolin, R. C. (1975). *Flowers and Plants of New South Wales and Southern Queensland.* A. H. & A. W. Reed, Sydney.

Scarth-Johnson, V. (1968). *Wildflowers of New South Wales.* Jacaranda, Brisbane.

Simmons, M. H. (1981). *Acacias of Australia.* Thomas Nelson, Melbourne.

Specht, R. L. (1972). *The Vegetation of South Australia.* 2nd ed. Government Printer, Adelaide.

Specht, R. L. (1979). The sclerophyllous (heath) vegetation of Australia: The eastern and central states. In *Ecosystems of the World. Volume 9A.* (ed. R. L. Specht). Elsevier, Amsterdam. pp 125–210.

Specht, R. L. (1981a). Conservation: Australian heathlands. In *Ecosystems of the World. Volume 9B.* (ed. R. L. Specht). Elsevier, Amsterdam. pp 235–240.

Specht, R. L. (1981b). Conservation of vegetation types. In *Australian Vegetation.* (ed. R. H. Groves). Cambridge University Press, Cambridge. pp 393–410.

Specht, R. L., Roe, E. M., and Boughton, V. H. (1974). Conservation of major plant communities in Australia and Papua New Guinea. *Aust. J. Bot., Suppl. Ser. No. 7.*

Whibley, D. J. E. (1980). *Acacias of South Australia.* Government Printer, Adelaide.

Willis, J. H. (1972). *A Handbook to Plants in Victoria. Volume II.* Melbourne University Press, Melbourne.

Wrigley, J. W. and Fagg, M. (1979). *Australian Native Plants.* Collins, Sydney.

# A Survey of the Aphodiinae, Hybosorinae and Scarabaeinae (Coleoptera: Scarabaeidae) from Small Wet Forests of coastal New South Wales, Part 4: Lansdowne State Forest

By G. A. Williams and T. Williams*

**Abstract**

Records of Aphodiinae, Hybosorinae and Scarabaeinae from a variety of forest types in the Lansdowne State Forest and several associated forest systems are listed. Data includes dates of collection, numbers of individuals encountered, vegetation and soil type at each study site, groundcover and bait type or collection method used. Range extensions are listed for several species. The occurrence of partial carpophagy (fruit eating) within the broad foraging strategy of *Onthophagus dunningi* Harold is noted.

**Introduction**

Part 4 of this survey is restricted to Lansdowne State Forest and several adjoining and associated forest systems. The area covered is situated approximately 16 km north of Taree, on the New South Wales north coast, and closely approaches the Comboyne Plateau to the northwest and Yarratt State Forest to the west (see Parts 2 and 3 Williams and Williams 1983a, 1983b).

Lansdowne State Forest, together with Coopernook State Forest to the southeast, constitute the Manning River National Forest; an area of approximately 7,000 hectares. The forest runs diagonally from Coopernook in the southeast to the northwest and in so doing rises from an altitude of 20 metres above sea level to over 500 metres. In the southwest the forest boundary is formed by a distinct uplift cliff face (Plate 1.) that, from the air appears as a sharply delimited scar. From this southwest cliff scar the forest drops away more gently to the northeast.

Primarily a hardwood forest, Lansdowne State Forest contains a variety of wet forest types, both gully restricted and in more spatially expansive tracts formed along slopes. Rainforest types are common, occurring either as pure stands or as a substantial understorey in wet sclerophyll forest. Subtropical palm forests also occur in the central sector of the forest. These are dominated by Bangalow Palms, *Archontophoenix cunninghamiana* (Wendl.) Wendl. et Drude, with the Walking Stick Palm, *Linospadix monostachyus* (Mart.) Wendl. occuring commonly on the forest floor.

Extending out from the state forest are a number of forests on private farmland and the extent of these, and the disposition of the study sites, are illustrated in Figure 1.

Eleven sites were sampled comprising a variety of vegetation types as well as a variety of land tenures. Sites A, B, C, D, F, G and H are contained within state forest whilst sites E, I, J are on private freehold land. Site K is restricted to a roadside easement. (Plates 2, 3.) Of these sites four were chosen for their comparative differences in vegetation status; site H was essentially a dry sclerophyll community with a venturesome wet forest component, site I is a wet sclerophyll forest regrowth interspersed with grassed areas whilst site J is a *Melaleuca-Eucalyptus-Callistemon* community associated with a small and shallow run-off gully. This site has a number of wet forest genera interspersed along the margins and within the understorey but most species are represented only by one or two individuals. Site K is composed mostly of "rainforest" species but the plant community is restricted almost totally to the creek and banks, an area rarely exceeding a width of 6 metres. In addition, the site is frequently inundated during heavy or continual rainfall. Sites J and K are now isolated from the main forest system and represent relict communities remaining after agricultural clearing. All of the study sites suffer from the establishment of introduced *Lantana camara*

* c/o Post Office, Lansdowne via Taree, N.S.W. 2430


Figure 1. Map of study sites.
A. Starr's Creek, Lansdowne S. F.
B. Newby's Creek "cave", Lansdowne S. F.
C. Pipeclay Creek Road, Lansdowne S. F.
D. Langley Vale Road, Lansdowne S. F.
E. Newby's Lane (rainforest).
F. Newby's Lane (wet scler. forest), Lansdowne S. F.
G. Newby's Lane (wet scler. forest), Lansdowne S. F.
H. Newby's Lane (dry scler. forest), Lansdowne S. F.
I. Newby's Lane (wet scler. forest regrowth).
J. Newby's Lane (dry scler. association).
K. Newby's Lane (rainforest/wet scler. forest association).

L. Verbenaceae, along both the site margins and as a component of the understorey where the forest canopy is open or disturbed.

The methods for capturing the beetles and the general presentation of data follows that for previous Parts (Williams and Williams 1982, 1983a, 1983b) though in this part little attempt was made to offer a variety or choice of pit-trap baits. There are no previous records of dung beetles from forest communities of the area.

As an adjunct to the main study some specific studies into possible carpophagy in the dung beetle *Onthophagus dunningi* Harold were carried out at site I. These results are tabled (Table 3) and discussed separately at the end of the main discussion.

The location of the study sites is figured (Fig. 1) and an indication of Lansdowne State Forest, in relation to Yarratt State Forest (Pt. 3) and the Comboyne Plateau (Pt. 2), is given (Fig. 2).

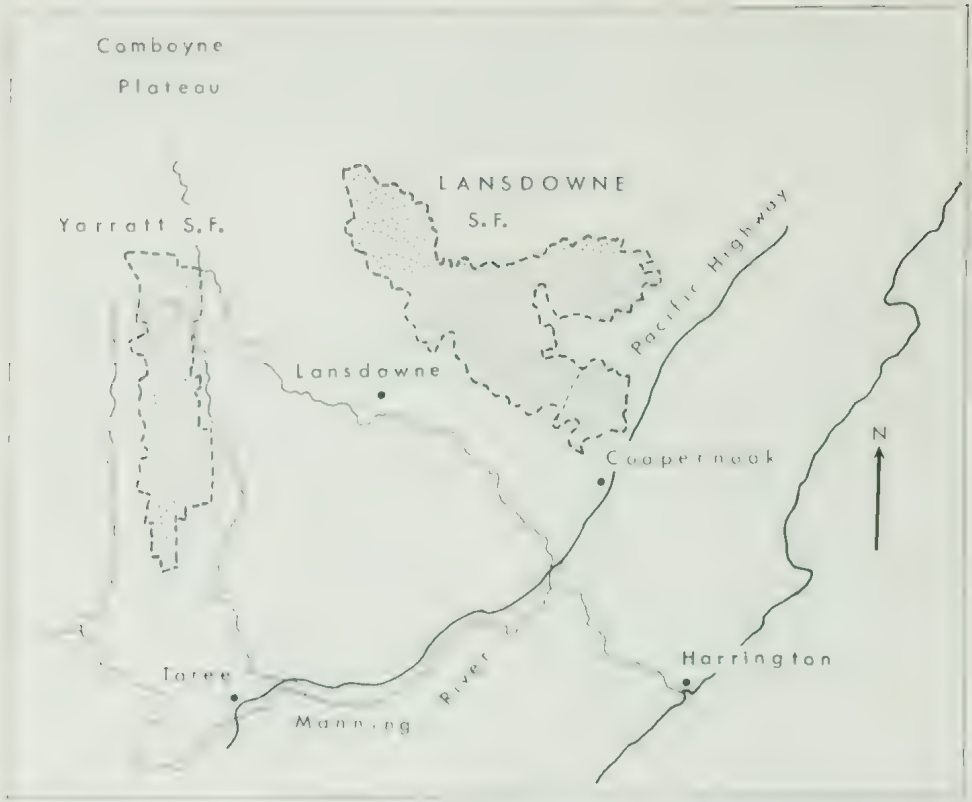



Figure 2. Map of Lansdowne State Forest indicating proximity to Yarratt State Forest (in Part 3) and the Comboyne Plateau (in Part 2).

Table 1. List of study sites and species taken at each. (Dates of collection are followed by figures in parenthesis indicating numbers of specimens taken.)

A. Starr's Creek Picnic Area (alt. 400 m). Subtropical-warm temperate rainforest association along creek gully. Red-brown clay-loam with moderate leaf litter cover.

*Liparochrus silphoides* Harold. 5.ii.1981,(1), at faeces.

*Diorygopyx incrassatus* Matthews. 5.ii.1981,(3), at faeces.

*Onthophagus kiambram* Storey. 5.ii.1981,(12), at faeces.

*Onthophagus pugnax* Harold. 5.ii.1981,(3), at faeces.

*Onthophagus sydneyensis* Blackburn. 5.ii.1981,(3), at faeces.

B. Newby's Creek "Cave" (alt. 260 m). Small gully restricted rainforest within dry sclerophyll forest regrowth. Dark brown sandy loam with heavy leaf litter cover. (see Plate 3.)

*Liparochrus silphoides* Harold. 5.ii.1981,(1), at faeces.

*Amphistomus speculifer* Matthews. 17.xi.1980,(1), at faeces.

*Diorygopyx incrassatus* Matthews. 19.x.1980,(5); 17.xi.1980,(5); 5.ii.1981,(6), at faeces.

*Lepanus bidentatus* (Wilson). 17.xi.1980,(1); 5.ii.1981,(1), at faeces.

*Onthophagus sydneyensis* Blackburn. 19.x.1980,(1); 5.ii.1981,(1), at faeces.

C. Pipeclay Creek Road (alt. 60 m). Subtropical palm forest surrounded by wet sclerophyll forest. Light brown loam soil with light density leaf litter cover.

*Liparochrus silphoides* Harold. 21.x.1980,(2); 17.xi.1980,(1); 5.ii.1981,(1), at faeces.

*Diorygopyx incrassatus* Matthews. 21.x.1980,(8); 5.ii.1981,(3), at faeces.

*Lepanus politus* (Carter). 5.ii.1981,(1), at bird dropping.

*Lepanus ustulatus* (Lansberge). 19.x.1980,(1), at faeces.

Plate 1. Section of southwest cliff face of Lansdowne State Forest above sites J and K.

Plate 2. Sites J and K showing degree of forest reduction in surrounding farmlands.

Plate 3. Gully restricted rainforest at Site B.

*Onthophagus bornemisszai* Matthews. 18.xi.1980,(1), in marsupial droppings on edge of palm forest and adjoining wet sclerophyll forest.
*Onthophagus capella* Kirby. 18.xi.1980,(1), in marsupial droppings on edge of palm forest and adjoining wet sclerophyll forest.
*Onthophagus kiambram* Storey. 5.ii.1981,(8), at faeces.
*Onthophagus sydneyensis* Blackburn. 5.ii.1981,(3), at faeces.
*Onthophagus sydneyensis* Blackburn ? 21.x.1980,(1), at faeces.

D. Langley Vale Road; previously known as Rocky Creek Road (alt. 40 m). Gully rainforest established under emergent wet sclerophyll forest elements. Brown sandy loam soil with heavy leaf litter cover.
*Liparochrus fossulatus* Westwood. 19.x.1980,(1), at faeces.
*Lepanus bidentatus* (Wilson). 17.xi.1980,(2), at faeces.
*Lepanus bidentatus* (Wilson) ? 17.xi.1980,(1), at faeces.
*Onthophagus capella* Kirby. 17.xi.1980,(1), at faeces.
*Onthophagus kiambram* Storey. 24.xii.1977,(2); 17.xi.1980,(3); 5.ii.1981,(1), at faeces.
*Onthophagus sydneyensis* Blackburn. 27.x.1978,(2); 17.xi.1980,(1), at faeces.

E. Newby's Lane (alt. 50 m). Warm temperate-subtropical rainforest association developed along creek and escarpment. Dark brown loam/sandy loam with light to heavy leaf litter cover.
*Ataenius picinus* Harold. 16.ix.1978,(1), at cow manure.
*Liparochrus silphoides* Harold. 10.ii.1980,(7); 19.x.1980,(1); 19.xi.1980,(10); 10.iv.1981,(6), at faeces.
*Amphistomus speculifer* Matthews. 19.x.1980,(2); 16.xi.1980,(2), at faeces.
*Diorygopyx incrassatus* Matthews. 19.x.1980,(1); 10.i.1981,(1), at faeces.
*Lepanus bidentatus* (Wilson). 19.x.1980,(1); 10.i.1981,(1), at faeces.
*Lepanus ustulatus* (Lansberge). 12.i.1981,(2); 10.ii.1981,(1), at faeces.
*Onthophagus bornemisszai* Matthews. 1.xii.1979,(2); 12.i.1981,(1), at faeces and in wallaby droppings.
*Onthophagus kiambram* Storey. 26.x.1978,(2); 24.ix.1980,(3); 19.x.1980,(1); 12.i.1981,(11); 10.ii.1981,(3), at faeces.
*Onthophagus capella* Kirby. 10.i.1981,(1), at faeces.
*Onthophagus neostenocerus* Goidanich. 10.ii.1980,(2), at faeces.
*Onthophagus pugnax* Harold. 10.ii.1980,(1), at faeces.
*Onthophagus sydneyensis* Blackburn. 10.ii.1981,(2); 10.iv.1981,(1), at faeces.

F. Newby's Lane (alt. 40 m). Wet sclerophyll forest restricted to shallow run-off gully, adjoining site E to the north. Brown loam soil, leaf litter removed in forest floor fire in August 1980 prior to the initiation of sampling.

*Ataenius imparilis* Blackburn. 15.xi.1980,(1), at faeces.

*Liparochrus fossulatus* Westwood. 23.ix.1980,(2), at faeces.

*Lepanus australis* Matthews. 10.iv.1981,(2), at faeces.

*Lepanus ustulatus* (Lansberge). 12.i.1981,(1); 7.ii.1981,(1); 13.x.1981,(2), at faeces.

*Notopedaria sylvestris* Matthews. 12.i.1981,(1); 7.ii.1981,(2), 11.ii.1981,(8); 13.x.1981,(1), at faeces.

*Onthophagus bornemisszai* Matthews. 12.i.1981,(3); 10.ii.1981,(1), at faeces.

*Onthophagus capella* Kirby. 12.i.1981,(9); 7.ii.1981,(5), at faeces.

*Onthophagus incornutus* Macleay. 26.x.1980,(1), at light.

*Onthophagus kiambram* Storey. 23.ix.1980,(1), at faeces.

*Onthophagus nurubuan* Matthews ? 12.i.1981,(1), at faeces.

*Onthophagus leanus* Goidanich. 8.ii.1981,(1), at faeces.

*Onthophagus pugnax* Harold. 12.i.1981,(1); 8.ii.1981,(1), at faeces.

*Onthophagus sydneyensis* Blackburn. 12.i.1981,(8); 10.iv.1981,(1), at faeces.

G. Newby's Lane (alt. 40 m). Wet sclerophyll forest adjoining site H to the south and site I to the north. Dark brown loam soil with medium to heavy leaf litter cover. This site was partially logged in July 1981 which resulted in considerable disturbance to the forest floor but with a canopy reduction of less than 40%.

*Liparochrus fossulatus* Westwood. 16.xi.1980,(1), at faeces.

*Aulacopris maximus* Matthews. 23.x.1980,(1), at faeces.

*Diorygopyx incrassatus* Matthews. 23.x.1980,(1), at faeces.

*Lepanus australis* Matthews. 10.iv.1981,(2); 4.i.1983,(1), at faeces.

*Lepanus ustulatus* (Lansberge). 14.i.1981,(3), at faeces.

*Notopedaria sylvestris* Matthews. 23.x.1980,(2), at faeces.

*Onthophagus auritus* Erichson. 4.i.1983,(1), at faeces.

*Onthophagus capella* Kirby. 16.xi.1980,(2); 4.i.1983,(5), at faeces.

*Onthophagus sydneyensis* Blackburn. 5.ii.1981,(1); 10.iv.1981,(1), at faeces.

H. Newby's Lane (alt. 40 m). Dry sclerophyll forest with some venturesome "wetter" elements. Brown-grey clay loam soil with medium to light leaf litter cover. Partially logged in July 1981 with only light, or locally heavy disturbance (eg. roading and log dumps), to the site.

*Liparochrus fossulatus* Westwood. 12.iv.1981,(2); 4.i.1983,(1), at faeces.

*Lepanus australis* Matthews. 12.iv.1981,(1); 18.iv.1981,(1), at faeces.

*Notopedaria sylvestris* Matthews. 26.x.1980,(9); 5.ii.1981,(7); 12.iv.1981,(2); 19.iv.1981,(15), at faeces.

*Onthophagus auritus* Erichson. 18.iv.1981,(2); 4.i.1983,(1), at faeces.

*Onthophagus bornemisszai* Matthews. 18.ix.1982,(1), in marsupial dropping.

*Onthophagus capella* Kirby. 5.ii.1981,(2); 10.iv.1981,(11); 19.iv.1981,(6); 4.i.1983,(2), at faeces and cow manure.

*Onthophagus dunningi* Harold. 12.iv.1981,(2), at faeces.

*Onthophagus granulatus* Boheman. 20.xi.1980,(1), in marsupial dropping.

*Onthophagus gazella* (Fab.). 10.iv.1981,(1), at cow manure but common in adjoining pasture.

*Onthophagus nurubuan* Matthews ? 10.iv.1981,(2); 17.iv.1981,(1), at faeces.

*Onthophagus leanus* Goidanich. 12.iv.1981,(1); 8.x.1982,(2); 15.xi.1982,(1), at faeces and cow manure.

*Onthophagus tweedensis* Blackburn. 8.x.1982,(1), under cow manure.

I. Newby's Lane (alt. 40 m). Partially cleared and regenerating wet sclerophyll forest adjoining site E (rainforest) and sites F and G (wet sclerophyll forest). Brown loam soil.

*Aphodius frenchi* Blackburn. 23.vi.1982,(4), at marsupial droppings.

*Ataenius picinus* Harold. 26.x.1980,(2); 15.xi.1980,(3); 4.i.1981,(1); 11.i.1981,(4), at u/v light.

*Ataenius tweedensis* Blackburn. 4.i.1981,(1), at u/v light.

*Proctophanes sculptus* Hope. 15.x.1977,(5); 16.ix.1978,(3), at cow manure.

*Liparochrus fossulatus* Westwood. 5.x.1980,(1); 25.viii.1982,(2); 29.x.1982(1), flying during day and at carrion (*Rattus fuscipes* (Waterhouse) (Muridae: Rodentia) and *Antechinus* sp. (Dasyuridae: Marsupialia)).

*Monoplistes leai* Paulian. 13.ix.1980,(1); 19.iv.1982,(1), at light.

*Onthophagus auritus* Erichson. 1.xii.1982,(3), at faeces.

*Onthophagus capella* Kirby. 10.xii.1978,(1); 18.iv.1981,(1) at faeces.

*Onthophagus depressus* Harold. 4.i.1981,(1), at u/v light.

*Onthophagus dunningi* Harold. 19.iv.1981,(5), at rotting watermelon: 6.v.1981,(1), found on ground.

*Onthophagus leanus* Goidanich. 21.iv.1979,(1); 4.xii.1980,(2), at light and cow manure.

*Onthophagus nurubuan* Matthews. 12.i.1981,(1); 14.iv.1981,(2), at cow manure.
*Onthophagus pugnax* Harold. 10.xii.1978,(1); 21.ix.1979,(1), at faeces and cow manure.
*Onthophagus sydneyensis* Blackburn. 16.ix.1979,(4), at wallaby droppings and cow manure.
*Onthophagus tweedensis* Blackburn. 23.xii.1977,(1), at wallaby droppings.

J. Newby's Lane (alt. 30 m). Dry sclerophyll association, restricted to shallow, seasonally dry, run-off gully. Some "wetter" forest spp. as venturesome component of understorey and margins. Light brown clay loam, open grazed forest floor. Surrounded by pasture.
*Lepanus australis* Matthews. 4.i.1983,(1), at faeces.
*Onthophagus capella* Kirby. 4.i.1983,(3), at faeces.

K. Newby's Lane (alt. 20 m). Narrow, creek-restricted, rainforest/wet sclerophyll association; seasonally inundated. Dark brown sandy loam. Surrounded by pasture.
* No spp. encountered over 5 sampling visits.

Table 2. Summary of species encountered.
(Letters indicate study sites; where indicated, specimens lodged in Australian National Insect Collection, Canberra)

Family Scarabaeidae.
Subfamily Aphodiinae.
*Aphodius frenchi* Blackburn. I.
*Ataenius imparilis* Blackburn. F.
*Ataenius picinus* Harold. E, I. Specimen in A.N.I.C.
*Ataenius tweedensis* Blackburn. I.
*Proctophanes sculptus* Hope. I. Specimen in A.N.I.C.

Subfamily Hybosorinae.
*Liparochrus fossulatus* Westwood. D, F, G, H, I. Specimen in A.N.I.C.
*Liparochrus silphoides* Harold. A, B, C, E. Specimen in A.N.I.C.

Subfamily Scarabaeinae.
Tribe Onthophagini.
*Onthophagus auritus* Erichson, G, H, I, Specimen in A.N.I.C.
*Onthophagus bornemisszai* Matthews, C, E, F, H. Specimen in A.N.I.C.
*Onthophagus capella* Kirby, C, D, E, F, G, H, I, J. Specimen in A.N.I.C.
*Onthophagus depressus* Harold. I. Specimen in A.N.I.C.
*Onthophagus dunningi* Harold, H, I. Specimen in A.N.I.C.
*Onthophagus gazella* (Fab.). H.
*Onthophagus granulatus* Boh. H.
*Onthophagus incornutus* Macleay. F.
*Onthophagus kiambram* Storey. A, C, D, E, F. Specimen in A.N.I.C.
*Onthophagus leanus* Goidanich. F, H, I. Specimen in A.N.I.C.
*Onthophagus neostenocerus* Goidanich. E.
*Onthophagus nurubuan* Matthews. I.
*Onthophagus nurubuan* Matthews? F, H. Specimen in A.N.I.C.
*Onthophagus pugnax* Harold. A, E, F, I. Specimen in A.N.I.C.
*Onthophagus sydneyensis* Blackburn. A, B, C, D, E, F, G, I. Specimen in A.N.I.C.
*Onthophagus sydneyensis* Blackburn ? C. Specimen in A.N.I.C.
*Onthophagus tweedensis* Blackburn. H, I. Specimen in A.N.I.C.

Tribe Scarabaeini.
*Amphistomus speculifer* Matthews. B, E. Specimen in A.N.I.C.
*Aulacopris maximus* Matthews. G.
*Diorygopyx incrassatus* Matthews. A, B, C, E, G. Specimen in A.N.I.C.
*Lepanus australis* Matthews. F, G, H, J. Specimen in A.N.I.C.
*Lepanus bidentatus* (Wilson). B, D, E.
*Lepanus bidentatus* (Wilson) ? D. Specimen in A.N.I.C.
*Lepanus politus* (Carter). C.
*Lepanus ustulatus* (Lansberge). C, E, F, G. Specimen in A.N.I.C.
*Monoplistes leai* Paulian. I.

Tribe Coprini.
*Notopedaria sylvestris* Matthews. F, G, H. Specimen in A.N.I.C.

## Discussion

The main period of sampling in this Part was undertaken between September 1980 and December 1982. Though the annual rainfall for the survey area is normally high (median annual rainfall of between 1400–1600 mm) three periods of excessive drought conditions coincided with the sampling period; spring and summer 1980, winter 1981 and late spring and early summer of 1982. Presumably these drought periods adversely affected the frequency with which the beetles occurred within the environment. However, during the total study, it has frequently been the case that light to heavy rainfall has occurred during sampling and on occasion rain continual-

ly fell whilst the pit-traps were in position. Rather than lessen catch returns in the traps, and as long as cool temperatures did not coincide with the rainfall, both the variety of species and the number of individuals taken were relatively rich. Thus a relative increase in moisture availability in both the soil and leaf litter cover may in some way act as an environmental stimulus to increased beetle activity.

The relict forest communities at sites J and K were sampled on 5 occasions (30 August 1982, 29 September 1982, 20 October 1982, 29 November 1982 and 2 January 1983) but only on the 2 January 1983, at site J, were any beetles taken. Neither of the 2 species collected at site J, on this last sampling, can be considered as purely wet forest species. *Onthophagus capella* Kirby is normally an inhabitant of more open habitats (Matthews 1972) whilst *Lepanus australis* Matthews appears to be capable of entering wet/dry forest interfaces limited possibly in its mobility by fluctuations in environmental moisture availability.

The apparent absence of a resident wet forest fauna over the 5 sampling periods at site K is not surprising given the physical restraints to site occupation. The site is very narrow and is subject to frequent inundation with no adjoining elevated forest areas available for temporary dispersal by the beetle community.

Only *Onthophagus sydneyensis* Blackburn was common to all the wet forest sites whilst *Notopedaria sylvestris* Matthews, which was encountered at wet and dry sclerophyll sites at Newby's Lane, was also taken in pasture adjoining sites G and H during and immediately after periods of heavy or continual rainfall.

Within the study area *Diorygopyx asciculifer* Matthews is replaced by the closely related *D. incrassatus* Matthews with *D. incrassatus* (previously recorded only from the Hastings River valley and the Comboyne Plateau) actually entering the Manning valley at 2 of the study sites (E and G). With the exception of a single individual taken at site G, in wet sclerophyll forest, *D. incrassatus* was restricted to rainforest.

The 2 hybosorines, *Liparochrus silphoides* Harold and *L. fossulatus* Westwood, are apparently mutually exclusive with *L. silphoides* occupying pure rainforest sites whilst the more mobile *L. fossulatus* occupies sclerophyll sites or wet sclerophyll-rainforest associations.

Several records are of additional interest. The occurrence of *Lepanus ustulatus* (Lansberge) represents a significant range extension southwards from the MacPherson Range on the Queensland border (Matthews 1974) whilst the occurrence of *Aulacopris maximus* Matthews at site G (elevation 40 m) is the first non-montane record for the species. The species was also taken at a submontane gully rainforest in Buladelah State forest to the south (Williams and Williams 1983b).

The genus *Aptenocanthon* does not penetrate to this study area though it is common at higher altitudes immediately to the west (Williams and Williams 1983a), nor does *Amphistomus primonactus* Matthews which was common both on the Comboyne Plateau and the Dingo Tops (Williams and Williams *loc.cit.*).

**Feeding Behaviour of *Onthophagus dunningi* Harold**

In Australia, endemic dung beetles of the tribe Onthophagini number 170 described species and all of these are placed in a single genus, *Onthophagus* (Matthews 1972). Most species are coprophagous whilst a significant element of the fauna (10 spp.) have been collected in association with agaric fungi (Matthews *loc.cit.*), though not all are necessarily obligate mycetophages. Only *Onthophagus vilis* Harold had previously been recorded, amongst the Australian fauna, as exhibiting carpophagous habits (Monteith and Storey 1981) but during the main study (though incidental to it) we took a number of *Onthophagus dunningi* Harold adults in a watermelon baited trap, set in wet sclerophyll forest regrowth at site I. The species had not previously been known to exhibit even partial carpophagous (fruit eating) habits.

*O. dunningi* is known from coastal sclerophyll forests from eastern Victoria to southern Queensland. In addition to being taken at toadstools and mushrooms the species is also found in excrement and entrails though Bornemissza (1971) has shown that adult *O. dunningi* appear to utilize only toadstools and mushrooms in the provisioning of their broods.

On the 19 April 1981, 5 adult *O. dunningi* (comprising both males and females) were

collected in a watermelon baited trap as mentioned previously. The trap consisted of a glass jar positioned above ground (13 cm high with a mouth width of 7.5 cm) over which was suspended an inverted aluminium pie dish. This configuration afforded a width of *ca.* 2 cm between jar mouth and dish edge for any insects to gain entry and was originally intended for the collection of Diptera. The height of the trap would have negated any possibility of incidental entry by the beetles.

In an attempt to gain some insight into the frequency with which carpophagy occurs in *O. dunningi*, two parallel trap lines, consisting of traps similar to the one mentioned above, were positioned at the original capture site on 21 March 1982. Each trap line consisted of five traps so that each of the following bait types were duplicated and offered simultaneously: chicken bones, faeces, mushrooms, watermelon and water (as a control). The individual baits were weighed to an approximate wet weight of 25–30 grams and once positioned were examined each day. The chicken bone and excrement baits were removed by a goanna, *Varanus varius* (Shaw) after 2–5 days, and the mushroom baited traps were removed on the 6th day by the authors. The melon baits were not removed until the observations were concluded on the 13th day. The results are shown in Table 3. Though *O. dunningi* adults were collected at chicken bones and mushrooms none were captured in melon baited traps.

Concurrently with this brief field study, several *O. dunningi* adults were placed into a large ventilated perspex container into which had been put a large watermelon segment and a damp wad of cottonwool. They were examined several times each day and night over a period of 7 days. The beetles rested beneath the cottonwool during daytime and each night actively fed upon the rotting melon.

It would appear from these observations that *Onthophagus dunningi* is a generalist feeder (when not brood provisioning), exhibiting low frequency carpophagous habits as part of its feeding strategy.

Table 3. Dung beetles trapped at simultaneously offered bait types.
(Letters indicate species, numerals indicate no. of individuals)

| Bait Type | Trap Line | Day 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10-13 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chicken bones | a | 0 | A2 | * | | | | | | | |
| | b | 0 | B6 | B6 | B5 | * | | | | | |
| Faeces | a | 0 | B2<br>C1<br>D1 | B1<br>D1 | * | | | | | | |
| | b | 0 | 0 | 0 | B1 | 0 | * | | | | |
| Watermelon | a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | b | 0 | 0 | 0 | 0 | 0 | 0 | 0 | B1 | B2 | 0 | 0 |
| Mushrooms | a | 0 | 0 | 0 | A1 | 0 | A1 | ** | - | - | - | - |
| | b | 0 | A1<br>B1 | A2 | A1 | 0 | 0 | ** | | | | |
| Water (control) | a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | b | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

A. *Onthophagus dunningi*. B. *Liparochrus fossulatus*. C. *Notopedaria sylvestris*. D. *Aulacopris maximus*.

* Trap disturbed and bait removed by *Varanus varius*

** Trap removed by author.

**Acknowledgements**

We would like to thank the Forestry Commission of New South Wales for permission to undertake studies within Lansdowne State Forest and in addition, the following Commission officers for their interest, advice and comments; Mr G. King, Mr B. Brooker, Mr W. Chapman and Mr H. Thomson. We would like to thank Mr T. Weir, CSIRO, Div. of Entomology, Canberra, for his comments on specimens deposited with the A.N.I.C., for bringing to our attention the paper by Monteith and Storey and for his critical examination of part of this paper whilst in an earlier draft. Dr E. G. Matthews, South Australian Museum, kindly identified a number of species.

REFERENCES

Bornemissza, G. F. (1971). Mycetophagous breeding in the Australian dung beetle, *Onthophagus dunningi*, *Pedobiologia 11:* 133-42.

Matthews, E. G. (1972). A revision of the Scarabaeine dung beetles of Australia. 1. Tribe Onthophagini. *Aust. J. Zool., Suppl. Ser. 9:* 1-330.

Matthews, E. G. (1974). A revision of the Scarabaeine dung beetles of Australia. 2. Tribe Scarabaeini. *Aust. J. Zool., Suppl. Ser. 24:* 1-221.

Monteith, G. B. and Storey, R. I. (1981). The biology of *Cephalodesmius*, a genus of dung beetles which synthesizes "dung" from plant material (Coleoptera: Scarabaeidae: Scarabaeinae). *Mem. Qld Mus. 20(2):* 253-77.

Williams, G. A. and Williams, T. (1982). A survey of the Aphodiinae, Hybosorinae and Scarabaeinae (Coleoptera: Scarabaeidae) from small wet forests of coastal New South Wales. Part 1: Nowra to Newcastle. *Aust. ent. Mag., 9(4):* 42-48.

Williams, G. A. and Williams, T. (1983a). A survey of the Aphodiinae, Hybosorinae and Scarabaeinae (Coleoptera: Scarabaeidae) from small wet forests of coastal New South Wales. Part 2: Barrington Tops to the Comboyne Plateau. *Victorian Nat. 100:* 25-30.

Williams, G. A. and Williams, T. (1983b). A survey of the Aphodiinae, Hybosorinae and Scarabaeinae (Coleoptera: Scarabaeidae) from small wet forests of coastal New South Wales. Part 3. Buladelah to Taree. *Victorian Nat. 100:* 98-105.

# Book Review

## '50 Walks in the Grampians'

BY TYRONE T. THOMAS

Rev. ed. pp. 140 (including 40 maps). Hill of Content, Melbourne, 1983. Rrp $8.95 paperback.

Owners of Tyrone Thomas' first slim edition of *50 Walks in the Grampians* will hardly recognise the new revised edition. It has expanded from a specialist pocket guide for walkers into a general guide to outdoor recreation in the Grampians. New material includes, for example, details of 5 car tours, maps and descriptions of 3 golf courses, and notes on picnicking, rock-climbing, swimming, horse-riding, painting and photography, lake activities and the Roses Gap Deer Park. Also included are 8 colour plates (of indifferent quality) and a number of botanical and other drawings of limited value. This increase in content is achieved at a cost in portability — the book is now nearly twice the weight of its predecessor and requires a pocket some 40 percent larger in area.

Despite the broader scope, the walker has not been neglected however. Many new walks are described (and others deleted to fit the title) and the number of detailed walk maps is increased from 13 to 27. All walk maps are now fully contoured. Regrettably, the map format has been changed from black on white to black on grey in order to allow each walk to be outlined as a white strip. Legibility of the finer detail, often the most important for a walker who is unfamiliar with an area, is reduced, and could suffer further if the maps have to be read through plastic in wet weather.

In addition to the new walks, some new sections in the book, which were not mentioned above, will also be of direct interest to many walkers. These include notes on wildflower walks, sandstone caves, Aboriginal art sites, a bird list with habitats and finally a list of map references to 250 features and places.

The walks themselves are now usefully grouped into two sections. The first 20 walks are those most suitable for families and none of these walks exceeds 10 km in length or an estimated 4 hours duration. The remaining 30 are for confirmed walkers and are classified in various ways, e.g. according to distance, duration (including any need to camp overnight), scenic importance and difficulty.

Concerning the usefulness and accuracy of the track notes, it is possible to say only that nothing was read by this reviewer that conflicts with his own observations remembered from the walks he knows. Moreover, the descriptions of the walks so far unsampled by him have confirmed a resolve to return and explore further the walking and recreation potential of this magnificent part of our State. *50 Walks in the Grampians* will most likely be in his haversack if not in his pocket.

**G. N. Christensen**

# Observations on *Pyrgoides dryops* (Blackburn) (Coleoptera: Chrysomelidae), a pollen-feeding beetle on *Acacia leiocalyx* (Domin) Pedley, at Brisbane, south-east Queensland.

BY T. J. HAWKESWOOD*

**Abstract**

*Pyrgoides dryops* (Blackburn) (Chrysomelidae: Paropsini) feeds on pollen from *Acacia leiocalyx* (Domin) Pedley (Mimosaceae) in the Brisbane area, south-east Queensland, during June and July. Although they are small beetles, observations have shown that the adults, during feeding and while moving over flowers, are able to contact anthers of the open *Acacia* flowers, thereby effecting geitonogamous pollinations.

**Introduction, Materials and Methods**

While collecting beetles (Coleoptera) from *Acacia* species in the Brisbane area during 1980, I discovered *Pyrgoides dryops* (Blackburn), a small black and orange chrysomelid beetle, often in moderate numbers on the fresh, open flowers of *Acacia leiocalyx* (Domin) Pedley (Mimosaceae). Further opportunity to study these beetles and their role in *Acacia* pollination at Brisbane did not arise until mid-June, 1982.

On 17 and 18 June 1982, I collected live beetles from the open flowers of *A. leiocalyx*, (growing near a creek on the Department of Primary Industries grounds at Indooroopilly, Brisbane), by placing a wide bottle containing tissue paper sprinkled with ethyl acetate as a killing agent, under a flowering inflorescence upon which beetles were feeding or resting. When the inflorescence was lightly tapped, the beetles usually dropped into the killing jar and were dead within a few seconds. Ethyl acetate was used as a quick killing agent to minimize loss of pollen from their bodes, since any prolonged activity by the beetles removes a large proportion of the pollen by scraping against the surfaces of the tissue paper or glass. Care was taken not to contaminate the collecting jar with anthers or pollen from the flowers.

A total of 21 *P. dryops* (Blackburn) were collected, as well as two specimens of the rarer, glossy black, *Ditropidus phalacroides* Baly. (Specimens of both species were compared with named material at Indooroopilly, Brisbane. However, pending revisions of both genera, their identification remains tentative).

In the laboratory, the beetles were examined for pollen under a high power (40X — 400X) dissecting microscope. The number of polyads (and whole anthers if present) were subsequently counted on different parts of the body of each beetle (for *P. dryops*, see Table 1). Field observations on adult behaviour of *P. dryops* and *D. phalacroides* on *A. leiocalyx* were also made at Indooroopilly (18 June), Kingston, c. 20 km S of Brisbane (22 June) and University of Queensland campus, St. Lucia, Brisbane (1 July).

*Acacia leiocalyx* (subsp. *leiocalyx)* is usually a handsome shrub or tree growing to about 6m high and is one of the most widespread species of the genus in Queensland (Pedley, 1978). The bright yellow flowers which possess a strong acrid odour, are arranged in spikes in axillary pairs on peduncles 3–8mm long, the corolla measures 1.5–2mm long, and the exserted stamens are 3–4mm long (Pedley, 1978). The pollen is released in polyads, each containing

* 49 Vennet Road, Annerley, Brisbane, Queensland, 4103.

Table 1. Distribution of polyads of Acacia leiocalyx on the bodies of 21 Pyrgoides dryops (Blackburn) collected on 17 & 18 June, 1982.

| Specimen Number | Head/ Eyes | Antennae | Thorax | Elytra/ Wings | Abdomen | Legs | Total | Specimen Number | Head/ Eyes | Antennae | Thorax | Elytra/ Wings | Abdomen | Legs | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 4 | 0 | 1 | 6 | 3 | 21 | 11 | 0 | 0 | 0 | 4 | 2 | 3 | 9 |
| 2 | 2 | 0 | 11 | 96 | 30 | 10 | 149 | 12 | 0 | 0 | 12 | 123 | 34 | 19 | 189 |
| 3 | 5 | 0 | 2 | 42 | 12 | 7 | 68 | 13 | 0 | 0 | 0 | 2 | 4 | 1 | 7 |
| 4 | 0 | 0 | 3 | 30 | 18 | 12 | 63 | 14 | 1 | 0 | 2 | 18 | 2 | 2 | 25 |
| 5 | 0 | 1 | 4 | 22 | 11 | 8 | 46 | 15 | 0 | 0 | 2 | 6 | 12 | 6 | 28 |
| 6 | 3 | 0 | 5 | 15 | 65 | 7 | 95 | 16 | 1 | 0 | 2 | 22 | 9 | 3 | 37 |
| 7 | 3 | 0 | 25 | 54 | 28 | 5 | 115 | 17 | 4 | 0 | 9 | 50 | 65 | 17 | 143 |
| 8 | 0 | 0 | 7 | 65 | 42 | 3 | 117 | 18 | 3 | 3 | 5 | 5 | 34 | 18 | 68 |
| 9 | 2 | 0 | 7 | 46 | 12 | 13 | 82 | 19 | 1 | 0 | 4 | 5 | 21 | 6 | 36 |
| 10 | 0 | | 2 | 20 | 5 | 2 | 29 | 20 | 2 | 1 | 4 | 75 | 5 | 2 | 89 |
| | | | | | | | | 21 | 1 | 1 | 6 | 31 | 6 | 5 | 50 |

Specimens 1-16 collected on 17 June, specimens 17-21 collected on 18 June.
17/6/82 – Range 7-189, $\bar{X}$ = 67.5, S.D. = 53.3; 18/6/82 – Range 36-143, $\bar{X}$ = 77.2, S.D. = 41.8.

16 pollen grains. Nectar is secreted at the base of each flower.

## Results

(a) Behavioural observations

The moderately common *Pyrgoides dryops* was usually encountered feeding on the pollen amongst open flowers of *Acacia leiocalyx* in bright sunlight. Some beetles in shady situations rested on the rhachis below the inflorescence. Mating sometimes occurred on the flowers but usually on the rhachis between flowers. Beetles were particularly wary and dropped from the flowers if disturbed. They fed exclusively on the pollen from the anthers by pushing their way through stamens and chewing the base of the anther or biting off the apex from the anther. The beetles did not appear to feed on nectar. Pollen and whole anthers adhering to the dorsal body surface of beetles were visible to the naked eye. Adults tended to remain on flowers of one inflorescence if not disturbed. No larvae were present either on leaves or flowers. Only a few individuals of *D. phalacroides* were present at each observation site. These were usually encountered resting or feeding within the stamens. Like *P. dryops* they dropped from the flowers if disturbed and mating occurred amongst the stamens.

(b) Pollen loads

All examined specimens of *P. dryops* (see Table 1) and *D. phalacroides* carried pollen of *A. leiocalyx*. Of 21 *P. dryops* examined (body length 2.5–3.0mm), only 2 specimens carried less than 15 polyads (Table 1). Most beetles carried the majority of their pollen loads on the elytra and abdomen, the largest surface areas of the beetles' body segments, and probably the areas most frequently contacting anthers of the flowers. Usually small numbers or no polyads were detected on the head, antennae or thorax (Table 1). Grooming by the beetles during rest periods may remove pollen from the head and antennae. Approximately 50% of *P. dryops* carried between 51 and 150 polyads (Fig. 1) while only one specimen carried more than 150 polyads. In addition to the polyads, specimen number 1 (Table 1) carried 2 whole anthers on the elytra; specimen 4 carried 3 anthers on the

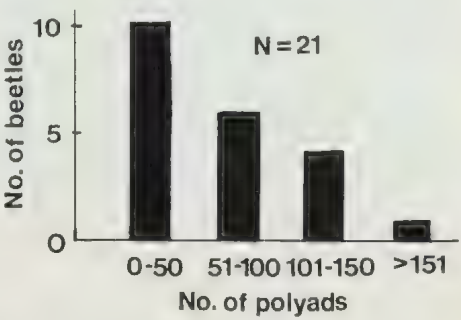



Fig. 1. Number of adult *P. dryops* carrying *Acacia* pollen, grouped into four classes.

elytra; specimen 5 carried 1 anther on left foreleg and 1 anther in the mouthparts; specimen 6 had one anther on the elytra; specimen 7 had part of an anther in the mouthparts and specimen 8 carried one anther on the head.

The two specimens of *D. phalacroides* (total body length c. 1.0mm), carried only small amounts of pollen (i.e. 3 and 11 polyads respectively, all on the elytra/wings; mean = 7.0, S.D. = 5.7), probably due to their small size and hence small surface area available for contacting anthers.

**Discussion**

New (1981) recorded the larvae of *Pyrgoides hamadryas* (Stal) as a pollinator of *Acacia baileyana* F. Muell. in Melbourne, Victoria, although did not observe any adult beetles on the flowers. New (1981) found *Acacia* pollen on the bodies of 37 out of 40 field-collected larvae, the quantity ranging from 2 to more than 100 "grains" (polyads?) per insect, while dissection showed that the gut content of the larvae consisted almost entirely of flower fragments.

Only adults of *P. dryops* were present on the flowers of *A. leiocalyx* in the Brisbane area during the observation periods. It is therefore interesting to note the absence of *Pyrgoides* larvae either on leaves or flowers when adults are present at Brisbane, and the reverse situation in Melbourne where larvae of *P. hamadryas* are present each year, but no adults are encountered (New, 1981).

Adults of *P. dryops* appear to be confined to flowers of *A. leiocalyx* in the Brisbane area where they are probably the main pollinators of this plant. However, their behaviour suggests that they play a more prominent role in geitonogamy (self-pollination) than xenogamy (cross-pollination), since adults tended to remain on the one inflorescence for long periods of time spending up to 30 minutes on the one flower before moving onto another one.

*Ditropidus phalacroides* probably does not play any significant role as a pollination vector due to its relative scarcity and small size.

**Acknowledgements**

Thanks are expressed to Messrs M. De Baar (Dept. of Forestry) and K. J. Houston (Dept. of Primary Industries), Indooroopilly, Brisbane, for allowing access to collections and microscopes and for helpful discussions concerning Coleoptera during my many visits to their institutions. Many thanks to Mr L. Pedley, Queensland Herbarium, for identifying *Acacia leiocalyx* and for discussions on various aspects of *Acacia* biology, taxonomy and distribution. This research was undertaken on private funds, and I thank my mother, Mrs D. E. Hawkeswood, for assistance.

REFERENCES

New, T. R. (1981). Paropsine beetle larvae as possible pollinators of *Acacia baileyana* in Victoria. *Aust. ent. Mag. 8:* 55.

Pedley, L. (1978). A revision of *Acacia* Mill. in Queensland. *Austrobaileya 1:* 75–234.

# Foraminifera in some Victorian Freshwater Streams

By K. N. Bell.*

During recent collecting from rivers and creeks in southern Victoria as part of a study of the Thecamoebian (testate rhizopods) fauna, several occurrences of living foraminifera were found.

Foraminifera are commonly believed to be inhabitants of marine and brackish waters only (Loeblich and Tappan, 1964). Over the years there have been reports of forams living in non-marine (athalassic) saline inland waters e.g. Rumanian salt ponds; Kara Kum desert; Algeria; Salton Sea, California; Caspian Sea, U.S.S.R.; and Hawaii (see Resig, 1974, for references). In 1942, W. J. Parr described, without identification, an occurrence of living forams from a salt lake at Douglas in the Western District, Vict. More recently Cann and deDekker (1981) have studied the foram fauna from salt lakes in the Coorong district of South Australia.

When we come to the consideration of forams living in freshwater, the evidence is sparse. Boltovskoy and Lena (1971) have recorded several species living in the Rio de la Plata (Argentina) and Boltovskoy (1976) has stated that several studies in freshwater lakes in the Province of Buenos Aires, in the Rio Quenquen Grande and in Laguna Dos Patos, southern Brazil, have shown forams to be capable of living in or being able to tolerate freshwater for a long time. Hedberg (1934) recorded an occurrence of foraminifera in tap water at Maracaibo, Venezuela. The salinity range of the water was given as 560 ppm to 3800 ppm (parts per million salt).

Before discussing the foram fauna found in Victorian streams we must consider what is meant by 'freshwater'. The dividing line between fresh and brackish water is a controversial and subjective matter which is often determined by the subject being considered. An extensive discussion of this boundary has been made by Bayly (1967).

In this paper I will follow Bayly and Williams (1973) in taking the upper boundary for freshwater as 3000 ppm (compare seawater about 36000 ppm).

The present samples which contained living foraminifera, as shown by staining with rose Bengal (a protoplasmic stain), came from 1, the Moorabool River at Russell's Bridge; 2, the Leigh River at Inverleigh; 3, Cargerie Creek on the Meredith — Mt. Mercer Road; 4, Bennison Creek, Foster. (see Fig. 1). Samples 1, 2, and 4 came from the banks of the streams just below the water level; in these cases the streams were flowing fast. Sample 3 came from the side of a large pool on the just flowing stream. Samples 1, 2, and 3 were collected on 5 May 1981 and sample 4 on 12 May 1981.

At each locality only the one foraminiferan, *Trochamminita irregularis* Cushman & Bronnimann, was found alive, although at Cargerie Ck. specimens of *Miliammina fusca* (Brady) were present but not living.

***Trochamminita irregularis*** Cushman & Bronnimann 1948

Test is planispiral initially with adult chambers often added in an irregular fashion. Wall is arenaceous, usually finely finished but the irregular chambers may incorporate large, angular quartz grains (see Fig. 2). Colour pale brown. Normally 6-7 inflated chambers in the last whorl, increasing rapidly in size; the irregular chambers are of variable size and added at random. Sutures are depressed, radial. The aperture is a single areal opening in the planispiral specimens but in adult chambers, multiple openings occur plac-

* Honorary Associate, Invertebrate Dept., National Museum of Victoria.

ed at random on the last chamber. All apertures are surrounded by a raised lip.

*T. irregularis* was originally described from the Maracas Bay River, Trinidad, West Indies (Cushman & Bronnimann, 1948). In Australia it has only been recorded from two small areas in Lake Wellington, Vict. (Apthorpe, 1980). *viz.* at the entrance to McLennans Straits (salinity 600 ppm) and at Poddy Bay, near the entrance of the Latrobe River (salinity not known, but at a SRWSC gauging station some 5 km out in L. Wellington the salinity was given as 300 — 5500 ppm.). The other faunal members found by Apthorpe at these two localities were not present in the freshwater stream samples.

Unfortunately salinities were not taken at the time of collection of the present samples (as foraminiferans were not expected), but through the courtesy of Mr G. J. G. Vines, Chief Engineer, Geelong Waterworks and Sewerage Trust, salinity data were provided for some samples.

1. Moorabool River at Russell's Bridge.

The river was running fast and filled the entire channel. Mr Vines informed me (letter 9 Feb 1982) that

"The GW&ST does not measure the salinity of the Moorabool R. below She Oaks [10 km. N of Russell's Bridge] but it is considered that the salinity level at Russell's Bridge would be similar to that at She Oaks, particularly as there are no significant tributaries in that reach. Furthermore, during the summer-autumn period the flow in the river is essentially stored water released from Bungal Dam . . ."

Fig. 1. Map showing stream sites containing live foraminifera
1. Russell's Bridge, Moorabool River.
2. Inverleigh, Leigh River.
3. Cargerie Creek.
4. Bennison Creek, Foster.

On 4 May 1981 the salinity at She Oaks was 235 ppm NaCl and from 5 Jan 1981 to 4 May 1981 the salinity ranged between 190 ppm NaCl to 300 ppm (based on weekly standardized conductivity determinations). One very early reading of salinity for the Moorabool R. at Batesford is given as 163 ppm (Aug 1946) and during May 1954 a value of 775 ppm (Strom, 1954).

So we can safely assume that the sample from Russell's Bridge came from freshwater.

2. Leigh River at Inverleigh.

The Leigh R. was fast flowing in the main channel. The only recent salinity readings available were taken in August-November 1978 at Inverleigh when the values were between 80 and 640 ppm. Strom (1954) gives a value of 990 ppm in May 1954.

Again the sample can be considered to come from freshwater.

3. Cargerie Creek.

This is a small stream rising in the Basalt Plains and flowing into the Leigh R. south of Mt. Mercer. No information is available at all on its salinity but as it was just flowing at the time of collection and as many of the Western District streams have relatively high and quite variable salinities during the summer-autumn months, we may accept that this sample came from a brackish water environment. The presence of *M. fusca* which is a brackish water species would also indicate this.

4. Bennison Creek, Foster.

Bennison Ck. is a small stream rising in the South Gippsland Hills and flowing into Corner Inlet. The creek was

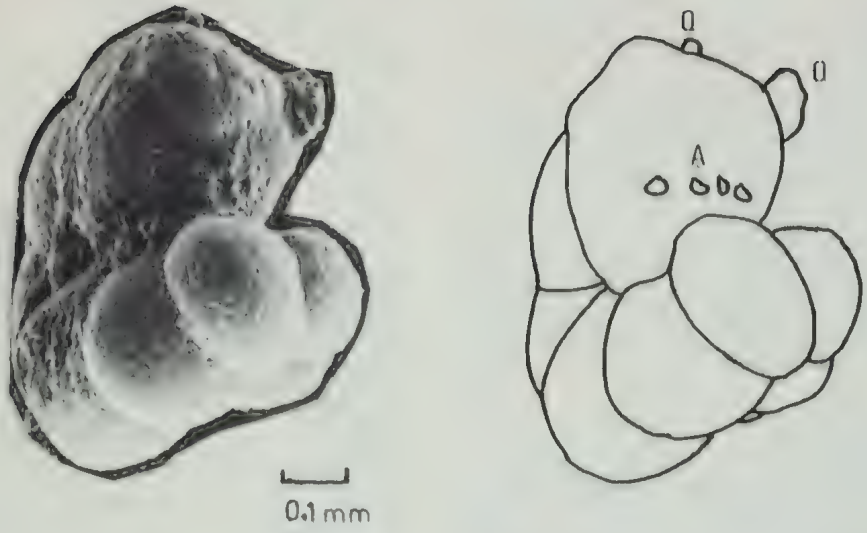



Fig. 2. *Trochamminita irregularis*, from Cargerie Ck. Note change in direction of coiling with adult chambers. A : apertures; Q : quartz grains incorporated in final chamber.

Photo: Courtesy of P. Bock, R.M.I.T.

flowing fast and just over its banks. The sample site was about 5 km. S-E of Foster. No salinity data are available. However, in the weed on the bank edges there was a very high number (many hundreds) of the gastropod *Potomopygrus niger* living. This gastropod is confined to freshwater (Smith & Kershaw, 1979, 1981), so we may assume that the forams were living in freshwater.

**Discussion.**

This is the first report of foraminiferans from freshwater streams in Victoria. For the Moorabool R., Leigh R. and Bennison Ck. there is no doubt that the waters were fresh at the time of collection, but the Cargerie Ck. sample is less certain. It would be of great interest if detailed regular collections were to be made to see whether the forams actually reproduce at these sites or whether they are introduced by some method and can survive but not reproduce. It has been shown for several species of brackish water forams that they can tolerate low salinities for considerable periods but need a certain minimum salinity before being able to reproduce (Bradshaw, 1956, 1961).

However, apart from Apthorpe's Lake Wellington specimens (Apthorpe, 1980) *T. irregularis* has not been found in any extensive foraminiferal faunal surveys along the Victorian coast (Victoria, Parr, 1932 a, b; Barwon Heads, Parr, 1945; Port Phillip, Collins, 1974; Western Port, Bell, 1971; Swan Bay, Bell, in prep.; Lake Connewarre, Bell, in prep.). These surveys were undertaken on normal marine and brackish estuarine sediments (e.g. the salinities in Lake Connewarre ranged from 4000 ppm to normal marine values). Therefore this would indicate that *T. irregularis* is only to be found in very low salinity and freshwater regimes and is not to be considered as a true marine

species able to tolerate low salinities for shorter or longer periods of time.

That they are found in such widely distant areas (Western Dist., South Gippsland) would seem to indicate that forams may be even more frequent members of stream faunas in Victoria than has previously been considered.

**Acknowledgements**

I would like to thank Mr G. J. G. Vines, Engineer-in-Chief, Geelong Waterworks and Sewerage Trust, for supplying information concerning the salinities along the Moorabool and Leigh Rivers.

REFERENCES

Apthorpe, M. 1980. Foraminiferal distribution in the Estuarine Gippsland Lakes System, Victoria. *Proc. Roy. Soc.* Vict. *91:* 207-228, 3pl.

Bayly, I. A. E. 1967. The general biological classification of aquatic environments with special reference to those in Australia. in: *Australian Inland Waters and their fauna: Eleven Studies.* (ed. A. H. Weatherley). A.N.U. Press, Canberra.

Bayly, I. A. E. and Williams, W. D. 1973. *Inland Waters and their Ecology.* Longman, Australia.

Bell, K. N., 1971. Foraminifera. in *Littoral Survey of Westernport Bay.* edit. B. J. Smith. Marine Study Group of Victoria.

Boltovskoy, E. 1976. Distribution of Recent Foraminifera of the South American Region. in: *Foraminifera, Vol 2.* (ed. R. H. Hedley and C. G. Adams). Academic Press, London.

Boltovskoy, E. and Lena, H. 1971. The Foraminifera (except Fam. Allogromiidae) which dwell in freshwater. *J. Foram. Res. vol. 1(2):* 71-76.

Bradshaw, J. S. 1957. Laboratory Studies on the rate of growth of the Foraminifer Streblus beccarii (Linn.) var. tepida (Cushman). *J. Paleont. vol 31(6):* 1138-1147.

Bradshaw, J. S. 1961. Laboratory Experiments on the Ecology of Foraminifera. *Contr. Cush. Fdn. Foram. Res. vol 12(3):* 87-106.

Cann, J. H. and deDeckker, P. 1981. Fossil Quaternary and Living foraminifera from Athalassic (non-marine) saline lakes, Southern Australia. *J. Paleont. vol 55(3):* 660-670, 3 pl.

Collins, A. C., 1974. Foraminiferida. Port Phillip Survey 1957-1963. *Mem. nat. mus. Vict. 35:* 1-61.

Cushman, J. A. and Bronnimann, P. 1948. Some new genera and species of Foraminifera from Brackish water of Trinidad. *Contr. Cush. Lab. Foram. Res. vol 24(1):* 15-21, 2 pl.

Hedberg, H. D. 1934. Some recent and Brackish to Freshwater Foraminifera. *J. Paleont. vol 8(4):* 469-476.

Loeblich, A. R. and Tappan, H. 1964. *Treatise on Invertebrate Paleontology, Part C. Protista 2.* Univ. Kansas Press.

Parr, W. J., 1932 a, b. Victorian Shallow Water Foraminifera. *Proc. Roy Soc. Vict. 44:* 1-15; 218-234.

Parr, W. J. 1942. Foraminifera. *The South Australian Nat. vol 21(3):* 1-9.

Parr, W. J., 1945. Recent Foraminifera from Barwon Heads, Victoria. *Proc. Roy. Soc. Vict. 56:* 189-218.

Resig, J. M. 1974. Recent Foraminifera from a Hawaiian Lake. *J. Foram. Res. vol 4:* 69-76.

Smith, B. J. and Kershaw, R. C. 1979. *Field Guide to the non-marine Molluscs of South-East. Australia.* A.N.U. Press.

Smith, B. J. and Kershaw, R. C. 1981. *Tasmanian Land and Freshwater Molluscs.* Fauna of Tasmania Handbook 5. Univ. Tas.

Strom, H. G. 1954. *The Barwon River and its Catchment.* State Rivers and Water Supply Commission (Roneo, Evidence to the Parliamentary Public Works Committee).

# A Comparison of Two Pitfall Trap Systems

By Richard W. Braithwaite*

**Abstract**

The mammals, reptiles and amphibians caught in a pitfall trap system using a short drift fence are compared with those obtained using a lid set slightly ajar. The former system caught 2.1 times as many vertebrate species and 3.7 times as many individuals as the second type. No species was caught exclusively in the lid-ajar system. Some considerations in the design of pitfall trap systems are discussed.

**Introduction**

The popularity of pitfall traps in fauna surveys has increased with the availability of portable motorized post-hole diggers and brushcutters; aids which reduced the considerable effort required to install pitfall systems. Pitfall traps are obviously superior for catching or establishing the presence of some components of the vertebrate fauna (e.g. Cockburn *et al.* 1978; Hopper 1981). However, the choice of pitfall trap systems (size, shape, material and placement of traps and drift fences, provision of shade, use of water, preservatives or bait, duration of use, *etc.*) designed for vertebrates appears to be largely intuitive.

In this report, two dissimilar pitfall systems are compared within the context of the Kakadu Fauna Survey, a quantitative ecological survey of the forested areas of Kakadu National Park, Northern Territory.

**Methods**

Twenty-seven sites were selected randomly within a three-way stratification of Stages I and II of Kakadu National Park (approximately 12,000 km$^2$): an area in a tropical wet and dry climate (see Story *et al.* 1969). Three sites were drawn from the pool of sites for each of three vegetation types (closed forest, open forest and woodland, *sensu* Specht 1970) in each of three geographic regions of the park. Two sites were located within proximity of human disturbance (within 3 km of roads) and the third site was remote from human activities.

Each site consisted of three sub-sites located at the apices of an equilateral triangle with 300 m sides. Each sub-site was 80 by 20 m and was orientated to maximize vegetation homogeneity. Around the perimeter of each sub-site were twenty Elliott trap sites at 10 m intervals and pitfalls were located midway between the Elliott trap sites. Successive positions were tested around this perimeter until eight pitfalls were successfully installed.

The traps used were ice cream cans 29 cm deep and 24 cm in diameter, with holes in the bottom to allow drainage. The lip of the can was level with the soil surface. Traps were operated for approximately 48 hours: from the afternoon of the first day to the morning of the third day. Traps were checked in the early morning and late afternoon on each day. Animals were generally released but a few were kept as voucher specimens. Two pitfall systems were used:

(a) The short drift fence system (SDF). A length of four metres of fine wire mesh (22 cm high), riveted to four supporting aluminium posts, was placed across the pitfall trap. Orientation of the fence was arbitrary.

(b) The lid-ajar system (LA). A 30 x 30 cm metal sheet was chocked open 2–3 cm by stones

* Division of Wildlife and Rangelands Research, CSIRO, PMB 44, Winnellie, N.T. 5789.

under one side. The lid was covered with soil for insulation.

Four pitfalls of each system were set at each sub-site between August 1 and December 12, 1980 (the period immediately preceding the wet season). Thus there was a total of 324 pitfalls for each system.

**Results**

The numbers of individuals of each species caught by either of the two pitfall trap systems are shown in Table 1. Although the values for the two pitfall systems at the 27 sites are significantly correlated ($r = 0.60$, $p < 0.001$), the SDF pitfalls recorded 2.1 times as many species and 3.7 times as many individuals as the LA type pitfalls.

The SDF pitfalls captured 29 species and the LA pitfalls 14 species. For lizards, the values were 24 (SDF) and 11 (LA) and the difference is statistically significant ($X^2_1 = 4.11$, $p < 0.05$). The

Table 1. Numbers of individuals of vertebrate species caught using the SDF and LA pitfall systems.

| Species | *Pitfall Systems* SDF | LA |
|---|---|---|
| Mammals | | |
| *Sminthopsis* sp. | 1 | 0 |
| *Pseudomys delicatulus* | 4 | 2 |
| *Melomys burtoni* | 1 | 0 |
| Reptiles | | |
| *Diplodactylus stenodactylus* | 3 | 0 |
| *Diplodactylus occultus* | 1 | 0 |
| *Heteronotia binoei* | 21 | 13 |
| *Delma borea* | 1 | 0 |
| *Diporiphora bilineata* | 11 | 1 |
| *Diporiphora magna* | 4 | 0 |
| *Lophognathus temporalis* | 1 | 0 |
| *Varanus timorensis* | 1 | 2 |
| *Carlia amax* | 25 | 4 |
| *Carlia foliorum* | 23 | 3 |
| *Carlia gracilis* | 1 | 1 |
| *Carlia triacantha* | 1 | 0 |
| *Cryptoblepharus plagiocephalus* | 7 | 0 |
| *Ctenotus essingtoni* | 12 | 2 |
| *Ctenotus robustus* | 1 | 0 |
| *Ctenotus storri* | 8 | 2 |
| *Ctenotus* sp. nov. | 4 | 1 |
| *Lerista karlschmidti* | 1 | 0 |
| *Menetia greyi* | 4 | 0 |
| *Menetia alanae* | 4 | 0 |
| *Morethia storri* | 8 | 5 |
| *Sphenomorphus crassicaudus* | 8 | 0 |
| *Sphenomorphus douglasi* | 1 | 0 |
| *Sphenomorphus isolepis* | 17 | 7 |
| Amphibians | | |
| *Platyplectron ornatus* | 6 | 1 |
| *Uperoleia inundata* | 26 | 11 |
| Total | 206 | 55 |

same two species of frogs were caught by both pitfall systems. Three mammal species were caught with the SDF pitfalls whereas only one was caught using the LA system. No species of mammal, reptile or amphibian was caught exclusively by the LA system.

With numbers of individuals of reptiles species, 167 (SDF) and 41 (LA) were caught in the two systems ($X^2_1 = 75.12$, $p < 0.001$). The amphibian values were 32 and 12 individuals respectively ($X^2_1 = 4.55$, $p < 0.05$). Six mammal specimens were caught in SDF pitfalls whereas two were caught in LA pitfalls. At the generic level, the values for *Uperoleia*, *Ctenotus* and *Sphenomorphus* are significantly different for the two systems; all preferred the SDF system.

Of the 29 species recorded, only *Varanus timorensis* was caught more frequently in the LA pitfalls (two captures) than the SDF pitfalls (one capture). Three species *(Heteronotia binoei, Morethia storri* and *Uperoleia inundata)* show a less marked preference for the SDF system.

In closed forest, open forest and woodland, the rates of SDF to LA results for all species were 3.6, 1.5 and 2.8 ($X^2_2 = 2.04$, n.s.) for numbers of species and 10.3, 2.8 and 4.4 ($X^2_2 = 4.14$, n.s.) for numbers of individuals. The three vegetation types all exhibit the same trend but open forest does so less strongly.

**Discussion**

The two pitfall trap systems tested were thought to represent systems which might prove effective with different components of the vertebrate fauna. For example, Banta (1967) suggested that the LA type of system may be favoured by some species because of the shade and tactile contact it provides. On the other hand the value of drift fences has long been appreciated. Fitzwater (1974) considered that to trap snakes without drift fences, baiting the trap with live animals was necessary; unless topography put the trap site in a natural funnel. As the SDF system appears more effective with all species, we can conclude that the drift fence is far more important than the shelter-security of the lid ajar. However, it remains unknown to what extent the drift fence causes the animals to accidentally fall into the trap or alternately, merely aids the discovery of the trap which the animal chooses to enter. While most animals cannot escape, some can be easily motivated to leap out. Presumably a few have chosen to remain in the trap and are not confined by it.

The various potentially advantageous characteristics which can be incorporated into pitfall trap systems are often not conflicting. The shelter of the LA system could, for example, be incorporated into a more complicated version of SDF system. Bait can also be used (Fitzwater 1974; Whitaker 1967) but Greenslade and Greenslade (1971) pointed out that bait attractiveness changes with age. However, as Pelikan *et al.* (1977) noted, the various invertebrates trapped in pitfalls increase their attractiveness to some vertebrate species. Both possibilities are eliminated by the use of preservatives. Although preservatives prevent trapped animals eating each other or being eaten by ants, the odour can be either an attractant or repellent to some species of invertebrates at least (Luff 1968). Similarly, spraying the floor of the trap with insecticide to discourage ants (Hopper 1981), may be inhibitory to some vertebrates. The influence of preservative odour may be minimized by topping with a layer of non-odorous mineral oil. (Tomlinson 1960). However, another drawback to the use of preservative is the large numbers of animals killed; an undesirable characteristic for many types of study.

Greenslade (1964) warns against pick-

ing 'good' spots for the placement of traps; either a systematic or a random scheme should be used. An advantage of the SDF system over systems involving long drift fences connecting several pitfall traps is that it can be used in a much wider range of situations (e.g. uneven terrain, heterogeneous soils).

Size of pitfall traps may also be important. With beetles, Luff (1974) found small traps tend to catch small animals and large traps catch large animals. Hence more than one size of trap would be desirable. Luff (1975) also found glass was better than plastic which was better than metal, for catching beetles. However, the use of glass precludes drainage holes. Usually materials for both traps and drift fences are chosen on cost and availability criteria rather than known effectiveness.

Decisions regarding a pitfall trap system may be influenced by the nature of the area where it is to be used. For example, Imler (1945) claimed "a fence of 8 or 9 inches high almost invariably turned snakes" aside in sparse or short grass but in dense and taller vegetation "a fence of 12 to 15 inches" was needed to stop snakes climbing over. In the present study there was no difference in preference for the two systems between the three vegetation types. As well as vegetation, weather can influence catch-effectiveness. Although both systems used drainage holes, if the watertable is high the traps fill with water. The ability of many animals to get out of the trap is influenced by the depth of water.

## Conclusion

There are many avenues open for further testing of the effectiveness of pitfall trap systems. Such work is needed, as the results presented here proved counter-intuitive. Instead of sampling different components of the vertebrate fauna, one system was simply much more effective than the other.

**Acknowledgements**

This study was aided by funds from the Australian National Parks and Wildlife Service through the Kakadu Fauna Survey consultancy agreements.

I particularly wish to thank Messrs J. A. Estbergs, J. C. Wombey and B. S. Parker for their assistance in the field and with computing. Dr M. G. Ridpath and Dr G. Friend critically reviewed a draft of the manuscipt.

REFERENCES

Banta, B. (1957). A simple trap for collecting desert reptiles *Herpetologica 13:* 174–76.

Cockburn, A., Fleming, M., and Wainer, J. (1978). The comparative effectiveness of drift fence pitfall trapping and conventional cage trapping of vertebrates in the Big Desert, north-western Victoria. *Victorian Nat. 96:* 92-5.

Greenslade, P. J. M. (1964). Pitfall trapping as a method for studying populations of Carabidae (Coleoptera) *J. Anim. Ecol. 33:* 301–10.

Greenslade, P., and Greenslade, P. J. M. (1971). The use of baits and preservatives in pitfall traps. *J. Aust. Ent. Soc. 10:* 253–60.

Fitzwater, W. D. (1974). Reptiles and Amphibians — A Management Dilemma. Proc. Sixth Vertebrate Pest Conference. pp. 178–183. (Vertebrate pest conference, Univ. of California: Davis).

Hopper, S. D. (1981). A pit trap survey of small mammals, lizards and frogs on the Two Peoples Bay Nature Reserve. *West. Aust. Dept. Fish. Wildl. Rep. 43.*

Imler, R. H. (1945). Bullsnakes and their control on a Nebraska Wildlife Refuge. *J. Wildl. Manage. 9:* 265-73.

Luff, M. L. (1968). Some effects of formalin on the numbers of Coleoptera caught in pitfall traps. *Entomol. Mon. Mag. 104:* 115–16.

Luff, M. L. (1975). Some features influencing the efficiency of pitfall traps. *Oecologia (Berl.) 19:* 345–57.

Pelikan, J. Z., Zejda, J., and Holisova, V. (1977). Efficiency of different traps in catching small mammals. *Folia Zoologica 26:* 1–13.

Specht, R. L. (1970). Vegetation In *"The Australian Environment"*. (Ed. G. W. Leeper) pp. 46–67, 4th ed. (Melbourne Univ. Press: Melbourne).

Story, R., Williams, M. A. J., Hooper, A. D. L., O'Ferral, R. E., and McAlpine, J. R. (1969). Lands of the Adelaide-Alligator Area, Northern Territory, Land Research Series No. 25. (CSIRO: Melbourne).

Tomlinson, J. (1960). A collecting device for small land animals. *The Veliger 2:* 97–8.

Whitaker, A. H. (1967). Baiting pitfall traps for small lizards. *Herpetologica 23:* 309–10.

## Restructure of Four State Government Departments into Two

The Premier announced on 9 June 1983 that there will be a restructure of four Departments to create two. The restructure is shown in the Table below.

| NEW DEPARTMENT<br>EXISTING DEPARTMENT | DEPARTMENT OF PLANNING AND ENVIRONMENT | DEPARTMENT OF CONSERVATION. FORESTS AND LANDS |
|---|---|---|
| PLANNING | Planning<br>Planning Appeals Board | |
| CONSERVATION | Land Conservation Council*<br>Victorian Archeological Survey*<br>Environment Assessment*<br>Conservation Planning (Part)*<br>Victoria Conservation Trust*<br>Victorian National Estates Committee*<br>Environment Protection Authority* | National Parks<br>Fisheries and Wildlife<br>Soil Conservation Authority<br>Zoological Board<br>Research Institutes<br>Conservation Planning (Part) |
| FORESTS COMMISSION | | Forests Commission |
| CROWN LANDS AND SURVEY | Coastal Management<br>Port Phillip Authority*<br>LANDATA Unit | Division of Survey and Mapping (excluding LANDATA)<br>Division of Crown Lands Management<br>Royal Botanic Gardens and Herbarium<br>Division of Land Administration<br>Vermin and Noxious Weeds Destruction (including Keith Turnbull Research Institute) |
| NEW UNIT | Environmental Commissioner | |

* Transfer to Department of Planning and Environment during Stage 1 of implementation (July)

### Stage 1 of the Change Process

The first stage of the change process, scheduled for completion in July, involves the reallocation of a number of units immediately to the new Department of Planning and Environment. The units to be considered for reallocation in Stage 1 are marked with an asterisk in the table.

### Stage 2 of the Change Process

The second stage of the change process scheduled for completion in October 1983 involves the development of detailed implementation plans for each new Department and the development of plans for the reallocation of remaining functions. The current Forests Commission restructure proposal will be considered as part of Stage 2.

# Eels

By J. P. Beumer*

Eels are a very large group of fishes and are perhaps one of the best known of all fish groups. Most people have either seen one or read or heard of the exploits of eels.

Being slender, elongate bony fishes, eels are often considered snake-like in appearance. Certain species of eels are covered with minute scales, embedded in the skin, while other species are completely free of scales. A single gill opening is present on each side of the head, just in front of the pectoral fin. No pelvic fins are present. The dorsal (top), caudal (tail) and anal (bottom) fins, if present, are usually continuous. Most species of eels have a large number of sharp but small teeth. Eels have long vertebral columns which may consist of several hundred vertebrae.

Eels originate from the Jurassic Age, between 135 and 180 M years ago. There are about 500 species of true eels. These eels are essentially those derived from the ancestral forms of the Jurassic Age and they have a complex life cycle which includes a planktonic larval stage. True eels may be found in fresh, brackish or salt water environments.

Within the true eels, there are a number of major groups. These include the freshwater eels, growing to 1.6 m; the marine worm eels, to 0.5 m; moray eels, a marine group, that grow to 3 to 4 m and inhabit reefs and rocky outcrops; and the conger eels, an estuarine and marine group, growing to 3 m in length. The electric eels of South America, are in fact, not true eels and are more closely related to the carp group of fishes.

*Freshwater Ecology Section
Arthur Rylah Institute for Environmental Research
123 Brown Street
HEIDELBERG, Vic. 3084.

One of the features common to the true eels is their life-cycle. There has been much speculation, discussion, and indeed, controversy, over where eels spawn and how their life cycle is actually completed. For a long time, eels were considered as "brides of snakes". Aristotle suggested that eels were the result of spontaneous generation. Pliny, another early philosopher, believed an eel rubbed its body against rocks and young eels formed from the slime.

Even Linnaeus and Van Leeuwenhoek had it wrong. They believed that the parasitic nematode worms, living in the body cavity of eels, were young eels and that eels were live-bearers. Eel-like organisms found in water-beetles were taken as juvenile eels. These organisms were later identified as Gordian or horse-hair worms which have insects as hosts. Other species of fish were also considered to produce eels. There is a species of fish in the Baltic Sea which even today is called Aalmutter or "mother of eels".

There were therefore an almost endless number of accounts as to how and where eels originated. Unfortunately, the majority of these ideas were totally incorrect.

The interest in the life cycle of eels was really just a part of the overall interest by the community in eels. This group of fishes has long occupied an important place within human society. In ancient Egypt, eels were considered sacred and raised to the status of a god. The Romans kept eels as pets in inland saltwater ponds. In New Zealand, the Maori version of the creation story has an eel rather than a snake in the Garden of Eden. It should be noted, however, that as there are no snakes in New Zealand, the eel makes a reasonable substitute!

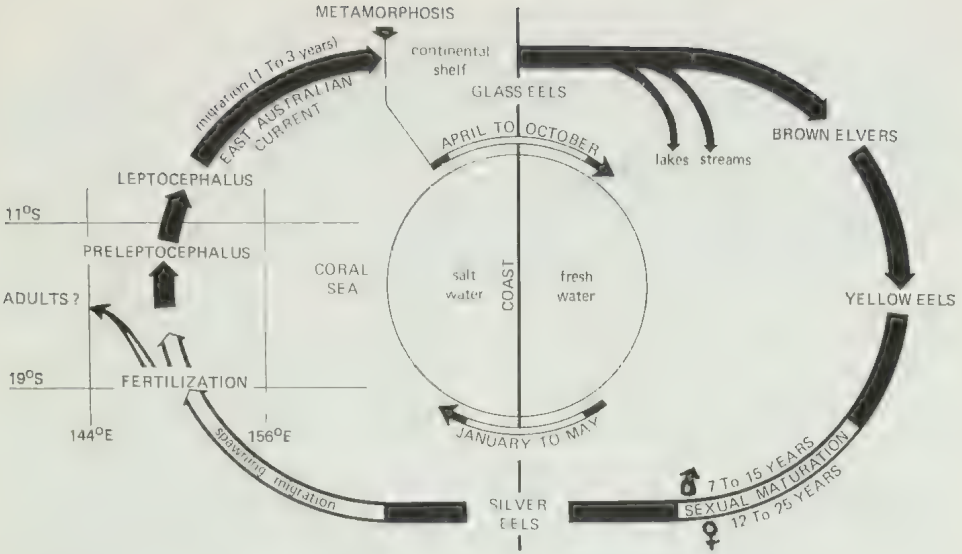



Fig. 1. Life cycle of *Anguilla australis*.

More recently, eels have been studied by the American Army. The blood serum of certain eel species contains a toxin, the properties of which are being investigated in the continuing research for biological weapons. The film, *The Tin Drum,* showed the graphic use of a horse's head to catch eels. In the *Guinness Book of Records,* the record for swallowing small eels is given as 1300 in 55 seconds.

Apart from an overall interest in eels as fascinating, yet mysterious fishes, freshwater eels have long been sought by man as a food item. Within Australia Aborigines sought eels because of the high fat content of these fishes. The eels were captured by a variety of methods including by hand; by traps woven from Cumbungi (or bullrushes) or by an elaborate system of channels, weirs and fish-traps as found at Lake Condah in south-western Victoria.

At present a small commercial eel fishery exists within Victoria. The fishery is based entirely on the two species of freshwater eels found in this State and is in the order of 200 tonnes per annum. The majority (95%) of this catch is exported overseas to Europe and South-East Asia. The remaining eels are processed and smoked for local markets.

**Freshwater Eels (*Anguilla* spp.)**

The true freshwater eels belong to the genus *Anguilla* in which there are about 16 species. These species occur throughout the world, both in the Atlantic and Indo-Pacific regions. *Anguilla* have been recorded from all continents except South America. Apart from Europe, the distribution of freshwater eels is on the eastern coastal regions, viz. Africa, India, Australia, South-East Asia, Canada and United States. This distribution reflects the southward or northward movements of tropical current systems from the Equator.

Within Australia, four species of *Anguilla* have been recorded. Three of these are classed as short-finned, the remaining one as long-finned. The short-finned eels, *A. bicolor* (north-western Australia), *A. obscura* (north-eastern Australia) and *A. australis* (Brisbane River, Queensland to South Australian/Victorian border and Tasmania),

have discrete distributions. The Long-finned Eel, *A. reinhardtii*, occurs along the entire east coast from Cape York, Queensland as far west as the Tarwin River, Victoria and as far south as Tasmania.

For all *Anguilla* species, the life cycle, although complex, is essentially the same and is punctuated with a number of clearly defined stages. The eels are catadromous with adults spawning at sea and the young migrating to freshwater streams and lakes. Spawning occurs in depths of 300 m or more at specific temperature, pressure and salinity gradients. For the three species of *Anguilla* from the east coast of Australia, the spawning grounds are thought to be located in the Coral Sea off North Queensland.

The fertilised eggs are planktonic and develop into leaf-shaped larvae called leptocephali. These are transparent and passive, being carried from the spawning grounds by the East Australian Current. The leptocephalus larvae were initially described as separate species because their shape is so radically different from the cylindrical eel-shape.

On approaching the Continental Shelf, the leptocephali change in body shape through a reduction in both depth and length to the familiar eel-shape. Now termed as glass-eels, there is no body pigment and the vertebrae, heart and stomach are clearly visible. Glass-eels migrate from the Continental Shelf to the estuaries and lower reaches of rivers. This migration is assisted by tidal movements but the glass-eels may remain in brackish waters for some time to allow physiological changes to occur which permit the transition from the marine to freshwater environment. Glass-eels are from 40-70 mm long and weigh approximately 0.2 g each.

While the estuarine migration occurs, glass-eels become increasingly more pigmented and when the body pigmentation is complete, the young eels are known as brown elvers. This stage of the life cycle may remain in the estuary or along with a number of glass-eels, migrate further upstream into lakes, swamps and headwaters of rivers and lakes. Migrations of brown elvers are relatively easy to observe where these eels have to bypass a natural (e.g. waterfall) or artificial (e.g. dam, weir) obstacle. In Victoria, the best known locality for upstream migration of brown elvers is the Hopkins Falls, near Warrnambool. Here the migration usually occurs in November.

The brown elvers feed and grow into the sexually immature stage, called yellow or brown feeding eels. These eels inhabit a particular area of river or lake for many years. e.g. up to 20 years, while feeding and development of the ovaries or testes occurs. Nocturnal in habit, the eels follow a seasonal activity pattern with a period of dormancy or hibernation in winter when water temperatures fall below 10-12°C.

Equipped with numerous very fine teeth, freshwater eels feed on any available aquatic organisms from insects, crustaceans and molluscs to other fishes and frogs. Cannibalism may also occur. Reports of eels feeding on ducklings and small mammals, such as mice, are common.

The yellow feeding eels develop into sexually mature silver eels. These have a completely different body coloration with a grey to black upper body and a white to silver lower body. The head region of silver eels is also quite distinctive with the pectoral fins darkening markedly and in some individuals, the fins have elongated for the increased swimming activity required enroute to the spawning grounds. An increase in eye size also occurs with the formation of a distinctive coppery sheen around the pupil of each eye. The enlarged eyes may be twice the size of those of the yellow feeding eel. The lateral line system also becomes more pronounced

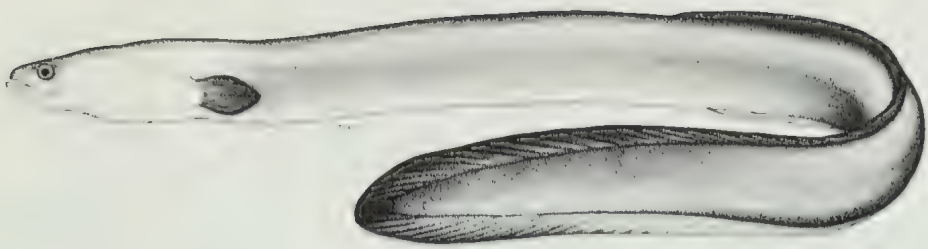


Plate 1. Short-finned eel *Anguilla australis*.

in silver eels. This system assists in the detection of vibrations and in maintaining the relative positions of individuals while migrating to the spawning grounds.

The migration from headwaters, lakes and swamps to the estuaries occurs during Spring and early summer. Silver eels congregate in the estuaries and migrate to sea during January to May in Victoria. The migrations peak each month around the last quarter phase of the moon between dusk and midnight before the moon rises.

Male silver eels are much smaller than the females. The males range from 37 to 55 cm in total length and 90 to 260 g in total weight compared to the females which measure 52 to 110 cm in length and 300 to 3200 g in weight. Females (12 to 25 years) are much longer lived than the males (7 to 15 years). Males make up a larger proportion of the seaward migration during January to March. Their relatively earlier departure than that of most females suggests that they may swim slower and by leaving earlier, may still arrive at the Coral Sea spawning grounds at the same time as the later leaving females.

It is uncertain how the eels find the exact location of the spawning grounds. For the freshwater eels from Victoria, these grounds are over 3000 km away, a distance which may take 2 to 3 months to be covered. Speeds of 50-60 km per day (2-2.5 km/hr) have been recorded for silver eels of the genus *Anguilla*. It may be possible that eels have within the head region, small quantities of a compound called magnetite: a material which has been found in other species that make extensive migrations, e.g. birds, several bee species, turtles, tuna and dolphins. This compound is an iron oxide ($Fe_3O_4$) which can act as a magnet and allows orientation of an organism to the Earth's magnetic field.

To conclude, it remains to say that the eels, and especially the freshwater eels of the genus *Anguilla*, exhibit a complex yet fascinating life cycle of which relatively few stages are fully understood. Despite the rigours of the life cycle with its many natural hazards enroute, freshwater eels in Victoria have up till now survived further, man-made pressures such as loss of habitat through land-reclamation schemes, pollution of waterways and erection of dams and weirs on streams. As eels are one of a limited number of groups of fishes utilising fresh, brackish and saltwater environments, changes in the abundance and distribution of this group may reflect the quality of these environments.

# The Derrinal Permian Glacial Valley Part 5†

BY FRANK ROBBINS*

**The Spring Plains area** — see 99:4, Fig. 2 for locality and Figs. 9 and 10.

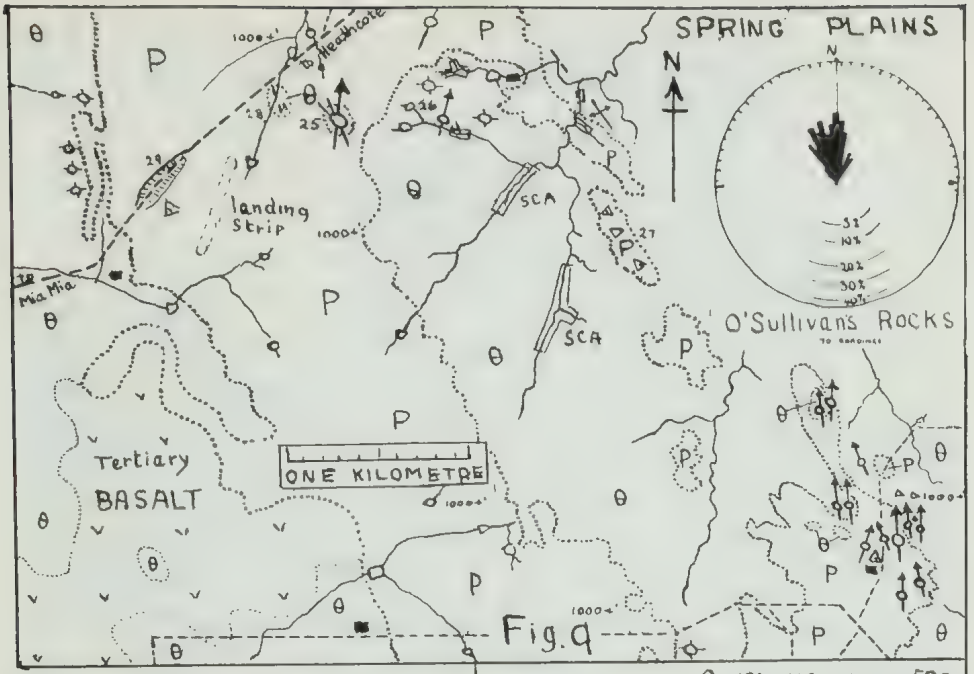
Only the northern part of the area has been previously geologically mapped and published by D. E. Thomas in 1941, Parish of Langwornor. The southern part has also been mapped by Eric Wilkinson of the Department of Minerals and Energy, Bendigo, but not published. He has also remapped the whole Permian glacial area.

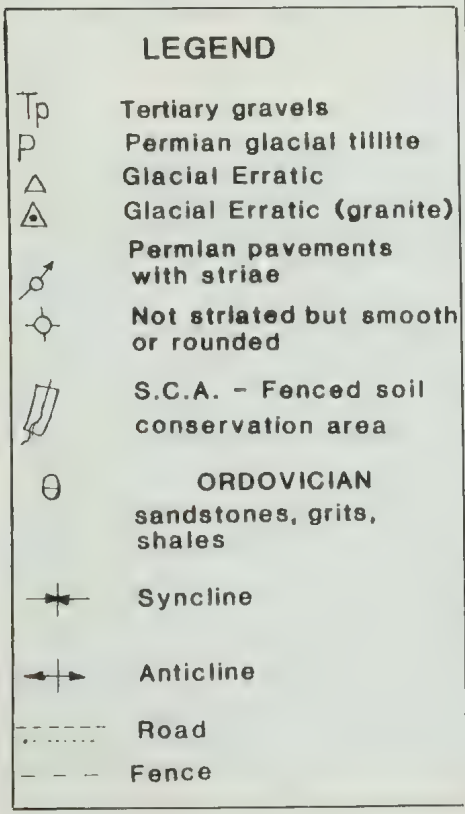
In the SW corner, the Permian glacial disappears under the Tertiary basalt at Mia Mia. Dunn (1892) had also shown this on his map, but the big surprise was the discovery by Eric of a huge striated rock dome or *roche moutonnée* under a large pine tree near W. O'Sullivan's house. Though close to a road, it had escaped notice by former geologists. Nearby are two other large *roches moutonnées* of meta-sandstone, obviously glacially striated and especially noticeable when excavated around the edges. Another very big elliptical *roche moutonnée* (see Fig. 10 — O'Sullivans No. 8 — shown 4-pointed) was found down the gully to the SE, but we failed to find any evidence of striae around the edges, or on it. Yet there were a number of striated basement rocks nearby (marked 6, 7, 9, 10). However, Jack Kellam and I had no doubt about the ice having travelled up this gully over all these rocks. In our enthusiasm over two days of excavating, recording and backfilling, we had found up to 46 smoothed and striated rock surfaces on basement, leaving no doubt that this whole area had been ice-worn by ice coming uphill from somewhere in the south i.e. another excellent exhumed surface of ancient Gondwanaland topography, rivalling that described in Part 4, but of smaller extent.

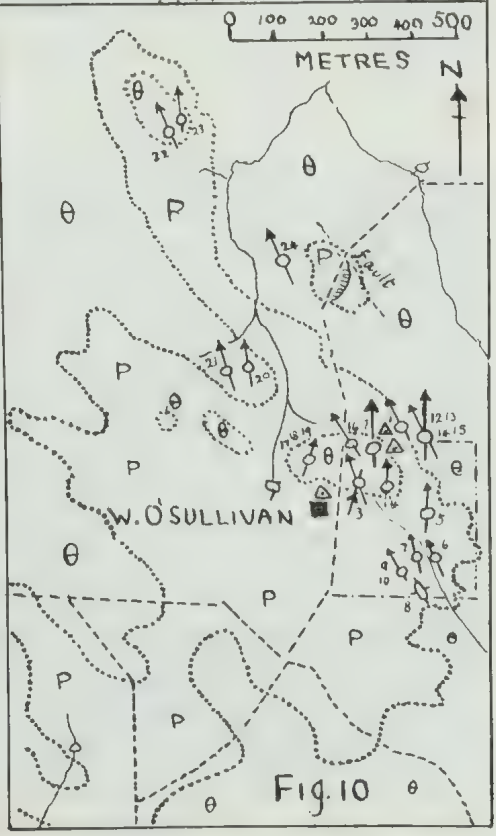
I have marked the highest parts of Fig. 9 with 1000+ ' (1000 ft. = 304.8 m A.S.L.) mostly within the glacial area, suggesting a wide main glacial valley in the west. The line of Permian outliers to the east suggests another narrower glacial valley somewhat like the Wild Duck Creek trough previously described. However, the striated area near O'Sullivan's house suggests a plateau over which the ice had completely overflowed, going right across the strike of the basement at some further 20° to the east, towards an area where there are no glacial deposits to be found. To the NE of the big striated rock (No. 1) under O'Sullivan's pine tree (which grows out of the rock) there are several large granite erratics on higher ground. And still further on and higher up, a rather flat plateau bears a large number of glacially striated basement surfaces, which indicates a great thickness of ice had once covered the whole area. A little further NE the ground surface suddenly sloped steeply downwards, which puzzled me, because no erratics or glacial evidence were obvious here, as would be expected. Was there a down-faulting here, or had differential erosion merely removed the glacial evidence, which I had expected there? In Fig. 10 I have shown a fault beside a road cutting in Permian to suggest this idea. If correct, it would be the only post-Permian fault in the glacial noted by us. Thomas' Langwornor map (1941) shows another fault at the Meadow Valley Dam, but I do not accept this as post-Permian, on the grounds that it is similar to so many other faults that he postulated, which we have shown to be untenable. I once tried an excavation on this one, which was not conclusive.

† *Continued from 100:1, p75.*

* 81 MacKenzie St., Bendigo, Vic. 3550.


SPRING PLAINS
N
landing Strip
SCA
SCA
O'Sullivans Rocks
Tertiary
BASALT
ONE KILOMETRE
Fig.9


LEGEND
Tp Tertiary gravels
P Permian glacial tillite
Glacial Erratic
Glacial Erratic (granite)
Permian pavements with striae
Not striated but smooth or rounded
S.C.A. - Fenced soil conservation area
θ ORDOVICIAN sandstones, grits, shales
Syncline
Anticline
Road
Fence


0 100 200 300 400 500
METRES
N
Fault
W.O'SULLIVAN
Fig.10

In Fig. 10, I have numbered the O'Sullivan striated rock groups from 1 to 24 to agree with the details in my field notes, in case someone might want to recheck our rich discovery of Gondwanaland relics. Of the large granite erratics, the biggest (No. 11) would weigh about 13 tonnes. A red granite erratic is nearby, and another big granite erratic is near the house.

I will not give details of the 46 or more glaciated rocks found — except for the three large ones *(roches moutonnées)*.

**O'Sullivans Rock No. 1** (see Plate 1) — a big somewhat elliptical dome of quartzite up to 2.7 m (9 ft.) above ground, and about 16.5 m (54 ft.) by 19 m (63 ft.) with a NS axis and an enormous pine tree growing out of its centre. The tree must be more than 100 years old, and must have protected the south and eastern sides of the rock for a very long time. The western rockface is much broken and would have been exposed to the hottest sun and severest storms. Whatever the reason, the ice striated it from the south at 0°T, moving up, over and around the east side leaving a spectacular scratched and smoothed surface, which is so well shaded by the tree that, to get a photo of it, we arrived there just after sunrise, when the sunshine was on it. It is a "must" when showing visitors our geological wonders. It still puzzles me how the surface is so well preserved, because it must have been exposed for hundreds of years before the pine tree grew there.

**O'Sullivans Nos. 3 and 4** — close by No. 1 on the south side — elongated and well above soil level — obviously a hard quartzite with dimensions of 8.8 m by 3.7 m (29 ft. x 12 ft.) and 5.5m by 2.7 m (18 ft. x 9 ft.) respectively and well rounded. Once well striated on top but exposure has removed striae from No. 3, although not entirely from No. 4. Excavations below soil level (see Plate 2) revealed beautifully preserved intersecting striae, which indicated ice movement towards No. 1 at close to 0°T. There was a stack of erratics beside No. 4 put there by the land owner long ago.

The above three rocks should be **Geological Monuments** to be protected against their use by quarry-men for road material.

It would appear that ice moved uphill from Nos. 6, 7, 8, 9, 10 towards Nos. 4, 3, 1, then turned northwards, because it met ice coming from the direction of O'Sullivan's house. Nos. 17, 18, 19 show striae running to E of N, while No. 16 (a group of six) show striae at about 330°T. This suggests that some of the ice at No. 1 changed direction from north and went down the valley to the NW.

**1. Campbell Pavement** — No. 25 on Fig. 9 — this remarkable glaciated rock of hard Ordovician meta-sandstone (see Plate 3) was first found by me on 11.1.68, then lost, rediscovered on 11.4.76, and excavated on 14.5.76. At almost the highest elevation in the area and barely above soil level, it can be located by a large tree stump on its centre. Apparently, it was originally a large elliptical dome or *roche moutonée*, 16 m x 8 m (17 yd. x 9 yd.) over which the ice had moved, shaping it elliptically in a NS direction. But the top, for some reason, has been removed or quarried away to almost soil level — I can't imagine Aborigines being responsible. By excavating at the SW end to a slant depth of 60 to 90 cm (2-3 ft.), we exposed a beautifully striated continuous arcuate surface of about 6 m (19 ft.), broken only by joints and sloping upwards at 25° to 35°, the striae running at 323°T to 353°T. In addition, at two places, there were strange dents like the Aboriginal peckings we had seen in N. Australia, or the effects of blows by a hard pointed tool. If they were of Aboriginal origin, they showed no sign of pattern. I would recommend to some future geologist-photographer to re-excavate it, clean and wash it, and rephotograph it as the sun moves round

Plate 1: Group of large rocks near O'Sullivan's house, striated by glacial ice action. O'Sullivans No. 1 in centre background. No. 3 to left and No.4 at right foreground.

Plate 2: O'Sullivans No. 3. Detail of intersecting striae on rock surface below soil level.

Plate 3: L. Campbell Pavement, a glaciated rock of hard Ordovician meta-sandstone showing striated surfaces exposed by excavation

to the best positions. It is a wonderful record, now hidden innocently in a farmer's paddock, of how ice moves upwards, over and around a large obstruction.

Nearby is another small Ordovician outcrop — which I would have liked to excavate for striae — indicating the Ordovician basement close to the surface here. Selwyn had marked this area on his No. 13 NE map of 1868 with the words "rock, rock, rock." (at 28 in Fig 9)

Other minor observations are a tillite cutting (No. 29), on the Mia Mia road near the hill-top, a number of large granite erratics on the Permian outlier (No. 27) — one was 1.8 m x 0.9 m (6 ft x 3 ft.) broken into several pieces. I have also marked with "4-pointed stars" seven basement rocks suspected of having been glacially rounded, but without evidence of glacial striae. At No. 26, we found possible evidence of two more glacial pavements, and nearby, a section of glacial beds in washouts described by R. L. Bowen (1959) but now obscured by soil conservation enclosures.

The only other large noteworthy granite erratics now broken into pieces by weathering in our Derrinal Valley are two in Farley's area (see Fig. 5 in Part 2), and one 5 km (3 miles) further north in Knowsley East parish (Dunn 1892). The largest granite erratics occur on the eastern side of the glacial valley, mostly at higher levels, but some are quite low e.g. one in a gully in Adair's (Fig. 8 — Part 4), and a few shown on the map in Part 2. The source of these large erratics would most likely be further south where the large Cobaw Batholith occurs, but we have not tried to match them.

Fig. 2 in Part 1 shows one more pavement (Longs Rock), north of Lake Eppalock, beyond the area of this series.

At this stage, we ceased further search for pavements etc. in the southern glacial area, thinking it wouldn't have added substantially to the picture

already gained of the wonderful exhumed glacial valley topography of ancient Gondwanaland. However, I continued on my own, mapping all exposures of glacial evidence at all creeks, gullies, washouts, farmer's dams etc. right up to the far north at Toolleen — now preserved in field notes, and nine detailed maps at the scale of the aerial photographs (1 km = 7 cm or approximately 1:14,300) for future reference.

In addition, I have a large collection of colour slides in both mono and stereo 35 mm of almost every pavement, together with a special viewer designed for stereo pairs. There is also a set of B & W stereo pairs together with the ancient viewer for the original Kellams Rock series. That is my way of preserving what we had exhumed and then interred.

Note: I have drawn a map covering from beyond Figs. 9, 10 to as far as Fig. 8. I can send a photocopy, if anyone really wants a full cover of all the southern end. Three black dots on Fig. 2 locate its position.

**Acknowledgments**

To Jack Kellam, who over the pleasant years, helped so energetically in digging up the past Gondwanaland story, and Eric Wilkinson, who joined us in July 1969 and added so much more knowledge to our venture.

REFERENCES

See previous issues especially

Selwyn, A. R. C. (1868). Geological map sheet 13SE.

Thomas, D. E. (1941). Geological map of Parish of Langwornor.

**Postcript:** Since I wrote Part 3 of the series on the Derrinal Glacial Valley, Lake Eppalock sank to its lowest level on 22.4.83 at 185.18 m (607.55 ft.) A.S.L., which is 0.33 m (1.08 ft.) lower than the previous record lowest level of 185.51 m (608.63 ft.) A.S.L. in the 1968 drought. The level is now slowly rising, but it may be a month or more before the remarkable interglacial pavement described in Vol. 100 p.34 is once again covered by water.

Anyone keen to see this wonderful glacial pavement should come to Moorabbee as soon as possible, as it may never be seen again, especially as the Full Supply Level may be raised several metres to meet any future disastrous water shortage at Bendigo.

Since Vol. 100 appeared, Graham Hill and I have made a detailed plan with numerous photos, both mono and stereo, to show what an interesting glacial feature of 1983 will be hidden below the water.

# Coastal *Eucalyptus pauciflora* in South Gippsland

By Pat Carolan*

Despite the very wide spread of *Eucalyptus pauciflora* (Snow Gum) in lowland situations, many casual observers of eucalypts still think of this species only as trees of the mountains. However, their occurrence near the mouth of the Powlett River (about 7 km NW of Wonthaggi) is unusual when compared with their other near-coast occurrences, e.g. on the Mornington Peninsula.

These trees were first brought to notice by Cecily Allen of this Club. I subsequently collected specimens which I took to Dr Pauline Ladiges of Melbourne University Botany Department who has since visited the area with research student Jann Williams who is studying lowland *E. pauciflora*. Seedlings will be grown from several trees including some which appear to be hybrids.

All the trees under investigation grow on the property of Mr Clive Hollins who is keenly interested in his trees and the environment generally.

The site is unusual because the trees grow to within about 0.5 km of the ocean (on a very high wave energy coast, facing SW) on gently undulating sand behind the high dune bordering the beach. On the north the land slopes down to the Powlett River flats. Mr Hollins said that the sand where the snow gums grow is free draining. The watertable varies and may be about a metre below the surface. The bedrock of Cretaceous arkose is visible on the beach at the base of the high dune. The site is a typical habitat for Coastal Tea Tree *(Leptospermum laevigatum)* which grows thickly in the uncleared areas and often shelters the wide-spreading but low *E. pauciflora* — a most unexpected association. Banksias grow nearby but not among the eucalypts. No trees seemed affected by the recent drought.

The *E. pauciflora* nearer the coast appears typical of the species, but a little further inland are about 20 varied hybrids and some peppermints which are not typical *E. radiata* (Narrow-leaved Peppermint) because juvenile leaves are broad and which also differ from other Victorian species of peppermint.

Probable hybrids *E. pauciflora* x *E. obliqua* (Messmate) and *E. pauciflora* x *E. radiata* occur on the Mornington Peninsula (within the Nepean State Park) but there the species grow in close proximity. The area at the Powlett River mouth is more puzzling. No *E. obliqua* were seen but the fruits of some trees resemble those of *E. obliqua* more than any other Victorian species. Such an occurrence has been called phantom hybridism as one of the suspected parents is now not present. But, in this area, some trees with partly rough bark and fruits much larger than any peppermint and most resembling *E. obliqua* fruit have leaves narrower than typical *E. pauciflora* and not at all like *E. obliqua* leaves. A branchlet of another tree indicates definite hybridism as most leaves are thin, narrow peppermint type but top leaves are typical of *E. pauciflora*.

Of the *Eucalyptus* Subgenus *Symphyomyrtus, E. viminalis* (Manna Gum) is common, with rare *E. ovata* (Swamp Gum) and probable hybrids between these species. There are a few trees which may have some relationship to *E. kitsoniana* (Gippsland Bog Gum).

Editors note.

The common name of 'White Sallee' is sometimes used for *E. pauciflora* rather than 'Snow Gum' because the natural distribution of this species is not confined to high altitudes.

*1/92 Were Street,
Brighton, Vic. 3186

## Victorian Native Orchid Survey

The habitat of native orchids has, since the advent of European settlement, been greatly reduced. This process still continues today. As well as continued clearing for agriculture and development, modern forestry practices are more intensive and may well affect orchid populations. Little is known of the distribution patterns of even the more common orchids and this project is an attempt to record the distribution of the remaining orchid flora.

Amateur groups have long been involved in collecting and centralizing distribution data for birds and mammals (Bird Observers Club and Mammal Survey groups) and have as a result been in a position to make positive steps towards conservation by such means as making submissions to the Land Conservation Council concerning future land usage.

A great deal of knowledge of local orchids is possessed by naturalists throughout Victoria and it is hoped that through the filling in and returning of forms this knowledge can be used to build up a picture of the status and distribution of both rare and common species. This project is supported by the FNCV and has been initiated by one of our members, Jenny Barnett, who was originally a Hawthorn Junior and later involved with mammal surveys. The project is expected to continue over a number of years to build up a good bank of data.

Any naturalists who enjoy finding, drawing or photographing orchids in the bush and who would like to take part in the survey please contact (Mrs) Jenny Barnett, P.O. Box 51, Yarra Glen, Vic 3775. Tel. 347 4222 ext 366 (B.H.)

Large Duck-orchid.

## Mrs Phyllis Matches

The Club has received a bequest of $500 by the late Mrs Phyllis Matches, to be used for or towards maintenance of native flora and fauna reserves. Council is investigating the possibilities of interesting the Sherbrooke Shire Council, and other persons, in the purchase of private land in the Courtney's Road area, to prevent the destruction by development of rare native orchids.

## Excursion to Kerang Wetlands — March 11-14th, 1983, for the Annual Get-Together of the Victorian Field Naturalists Clubs Association

We wondered if the great drought and devastating bushfires in Victoria would prevent members attending the meeting and leaving their farms and/or gardens, and whether there would be any wetlands remaining; however, more than 50 persons attended from 8 clubs as far afield as Stawell, Warragul, Benalla, Latrobe Valley, Wangaratta and Melbourne. The Mid-Murray Club acted as hosts at Macropus Park 18 km south west of Kerang where George Hardwick and his family have established a 'host farm' on a 200 ha. mixed irrigation property adjoining the Appin State Forest, where there were cabins, camping facilities and a recreation hall. Mid-Murray members Rod Chick, Neil Macfarlane, Jack Hayward and Bert Curtis showed slides and movies of local natural features on Saturday night — and the Kerang Camera Club led by Brian Walton showed natural history slides on Sunday night.

The first excursion was led by Tom Lowe and Bob Swindley to marshes and lakes north west of Kerang, in a temperature of over 35°C. North of Lake Charm — Kelly's Lake provided sightings of numerous water birds, three Freckled Duck had been spotted by the host club; there were many Pelicans, Black Swans, Red-necked Avocets, sand-pipers, dotterels and a solitary Eastern Curlew. An amazing sight confronted the party at the first marsh where tons of dried, stinking European Carp lay in long sinuous lines where the water had receded — most of these fish were 45 cm to 60 cm long and are apparently infesting all the lakes in the district. At Lake Bael Bael many tons of living carp were being netted for the commercial pet food industry.

There was a great deal of discussion on the salting which is affecting both irrigation and non-irrigation areas mainly in the north west of Victoria, and there were many patches of bare ground with crystallized salt visible on the surrounding farm lands, and more salt bushes grew thereon. It was possible to recognize saltland by identifying salt-indicating plants such as the Nitre Goosefoot *(Chenopodium nitrariaceum)*, Grey Glasswort *(Halosarcia halocnemoides)*, Swamp Rat-tail Grass *(Sporobolus mitchellii)*, Prickly Salwort *(Salsola kali)*, Sea Barley Grass *(Hordeum marinum)* and Red Sand-spurrey *(Spergularia rubra)*, a yellow-flowered *Abutilon otocarpum* and a blue *Mimulus* species.

The causes of salting and its devastating effects seem to be understood and methods of control have been defined. The chief long-term key to cure seems to be lowering of the water table, and many agencies are offering advice and assistance. But beneficial results seem to be elusive and many millions of dollars are lost from farmland production each year.

After a swim in Lake Kangaroo, lunch was eaten in the shade of willows on the banks, and a visit to Lake Cullen completed the day.

On the second day we crossed the Gunbower Creek at Spencer's Bridge and spent a day on Gunbower Island, which remains a fine River Red Gum forest *(Eucalyptus camaldulensis)* with some Black Box *(E. largiflorens)*. The most colorful of the few flowers observed was the yellow Clove-strip *(Ludwigia peploides)*.

We were interested to observe 'kino trees' — old, long dead red gums whose trunks had been irregularly hacked and pock-marked to collect 'resin' for tanning.

A highlight of the trip was listening to the tales of an old, tattooed, toothless charcoal burner, who had camped on

the island for more than fifty years. He had inadvertently disturbed the grave of an Aborigine and believed he had had no luck since that day — he had reverently re-buried the bones and surmounted the grave with a cross!

The carapaces of several Long-necked Tortoises were found and many animal bones, and some chipped quartz artefacts.

A visit was made to the tiny town of Koondrook on the River Murray, where saw-mills convert the red gum to railway sleepers, and there is a small, picturesque disused railway station.

On the final day, Labour Day holiday in Victoria, the excursion was to the Reedy Lakes where there is a large ibis rookery and both White and Straw-necked Ibis nest at different times. Many ducks were sighted but they were extremely timorous and had not appreciated that the duck shooting season had been cancelled this year because of the drought. Mary Doery informed us that we might discover pearls inside the shells of the freshwater mussels lying on the cracked mud of the receding lake waters — George Hardwick opened one in disbelief and found a good half teaspoonful of seed pearls and a mother-of-pearl coating over the remains of the dead mollusc.

The highlight of the trip was viewing a 2 metre Carpet Snake initially curled in a figure-of-eight over a protruberance on a dead red gum on the opposite side of the water channel at Reedy Lake No. 3. Small birds were "dive-bombing" the animal whose body looked bulgy in one area, and whose tail was being slowly withdrawn from a hole in the tree trunk!

After lunch a visit was made to Dartagook State Forest, which was very dry Black Box country with a ground cover of Tangled Lignum *(Muehlenbeckia cunninghamii).* One lilac *Eremophila* species was the only flower discovered.

More than 80 species of birds were listed including several Emu — one Glossy Ibis, Nankeen Night Herons, and a flock of godwits. Environmental conditions meant that the botanists had to spend most of their time and interest trying to identify salt-indicating plants of at least 30 different species.

Photographs were taken of Laura White and Marie Allender for the records of Macropus Park and two eucalypts were planted there, before most of the party left Kerang by the evening train for Melbourne.

---

## Miss Jean Blackburn

Members will be saddened to hear of the death of Jean Blackburn on 14th July, 1983. Jean was elected to the club in 1946 and was an active member until her illness last year. An obituary will appear in the next issue.

---

## Royal Melbourne Show

The Secretary is appealing for volunteers to man a publicity stand at the forthcoming Royal Melbourne Show daily from 4.30-10.00 p.m. for the duration of the Show, 15th-24th September. If you can help or want more information, ring Sheila Houghton on 551 2708 (A.H.)

# Field Naturalists Club of Victoria

## Reports of recent activities

### General Meeting
### Monday, 6th June

**The proposed speaker** for the evening, Dr Newman, was prevented by illness from attending the meeting. At very short notice Mr Malcolm Turner, President of the Hawthorn Junior F.N.C. and an Education Officer with the National Parks Service, played an audio-visual cassette, prepared by the Interpretation Section of the National Parks Service as part of their presentation at Wilsons Promontory. Mr Turner reported on the extent of damage to the National Parks by bushfires during last Summer.

**Conservation:** Malcolm Turner and Mr Julian Grusovin spoke on the L.C.C. Proposed Recommendations for the Alpine Study Area, which were considered to be most disappointing to conservationists. Members were urged to write individually to the L.C.C. in favour of a large Alpine National Park, contiguous with the Kosciusko National Park.

**Exhibits & Nature Notes:** The marine polychaete worm *Polydora,* was displayed under the microscope.

Also on display was a collection of fungi from the Buxton area, including *Lepiota* sp., *Cortinars, Ramaria gracilis, Amanita umbrinella, Pluteolus* sp., *Lycoperdon glabrescens, Stereum hirsutum, Clitocybe infundibiliformis.*

A stuffed specimen of the Long-nosed Bandicoot and samples of that species' scats provided members with the opportunity to become more familiar with the animal.

From the suburbs came reports of Ring-tailed Possums and their nests. One member reported an unusual number of fallen Coast Banksia cones, most of which contained grubs whose identity hopefully would become known when the adult emerged.

There was also a report of albinism in the Blackbird and Yellow-rumped Thornbill.

### General Meeting
### Monday, 11th July

**Honorary Memberships** were conferred on Mr Eric Muir and Dr William Geroe who have both completed 40 years membership.

**Speaker** for the evening was Mr Eric Muir who talked on the Little Desert. It was pointed out that the description 'desert' is a misnomer as the area is rich in wildlife. For example within its 300,000 acres exist approximately 600 plant species which includes 38 species of orchids and the very rare *Acacia enterocarpa,* or 'Jumping Jack Wattle'. Also well represented are bird species, 160 being recorded in the region. He described the area as being a 'showplace' in Spring, especially after rains. The abundance of blooms is evidenced by the fact that the area is popular with beekeepers.

The Little Desert is an area of land that was formerly submerged by a sea that occupied the Murray basin. Evidence of this are the 30 or so shallow sand-ridges which traverse the region. These are former beach dunes that were left behind by the retreating sea. With the coming of white man came changes to the vegetation mainly due to the introduction of sheep and the associated effects such as the introduction of exotic grasses and the practice of systematic burning to promote succulent new growth for grazing. The effect of this was that some plants were promoted (e.g. *Banksias*) while others disappeared altogether. The overall change to the vegetation is that today it is much less open than it was prior to its use by white man.

Mr Muir spoke of the controversy that errupted in 1968 when the Government of the day moved to set aside a large area of the region for settlement with only a relatively small area reserved for National Park status. After strong opposition from all sectors of the general public the Government finally dropped this idea and the bulk of the Little Desert region was proclaimed a National Park. Today there are few properties in the area.

**Conservation:** Mr Malcolm Turner made mention of the recent "No Dams" victory for conservationists (referring to the High Court decision). However, he reminded members that the South-west area is still under threat due to proposals for other dams, mining and woodchipping.

With respect to the L.C.C.'s proposed recommendations for the alpine area, Mr Turner explained that the Conservation Committee had organised a 'how to write a submission' sheet to help members and others in their task. He then went on to give a summary of the proposed recommendations and outlined some aspects of the recommendations which fall short of the wishes of the F.N.C.V. and conservationists in general.

**Exhibits & Nature Notes:** Some information on the pH scale was provided while displayed under a low-power microscope was the hydroid *Ophiodissus australis* from Black Rock. Showing the effects of an attack from fungus beetles was a specimen of white punk fungus, *Piptoporus portentosus.* Also showing the effects of animal attack was a polystyrene fruit case which a member found was subject to repeated pecking by the birds in his garden, for no apparent reason.

Several members recounted other incidents of attack by birds on man-made structures, viz. sparrows peeling fibreglass strips from corrugated fibreglass roofing in Spring, and birds removing unhardened putty from around windows. Other reports pointed out the unusually high numbers of blossom-feeding birds around Melbourne and the strength of a spider's silken thread, the question being asked "what gives a spider's web its great strength?"

The Mammal Survey Group reported that the Leadbeater's Possum survey at Tooronga was not successful in terms of Leadbeater sightings, mainly due to a fairly heavy snow cover. Nevertheless, the snow cover enabled one member to develop a new technique of spot-lighting on skis.

---

(Continued from inside front cover)

## GROUP MEETINGS

FNCV members are invited to attend any Group meeting.

**Day Group — Third Thursday.**

Thursday, 18th August. Zoological Gardens led by D. McInnes (ph. 211 2427)

Thursday, 15th September. Bay Road Reserve Heathlands Sanctuary (Sandringham) led by A. Fairhall (ph. 578 2009)

Thursday, 20th October. Monash University grounds led by J. Zirkler (ph. 568 8337)

**At the National Herbarium, Birdwood Avenue, South Yarra, at 8.00 p.m.**

**Botany Group — Second Thursday**

Thursday, 11th August. Trevor Blake, Proteaceae.

Thursday, 8th September. Acacias.

Thursday, 13th October. Ilma Dunn. Kangaroo Island.

**Geology Greoup — First Wednesday**

Wednesday, 7th September. "What mineral is that?" — A group exercise.

Wednesday, 5th October. "A profile of the Earth under the Oceans."

**Mammal Survey Group — First Tuesday**

Tuesday, 6th September. Bob Warneke. Seals.

Tuesday, 4th October. Lester Pahl. Population biology and diet of the Ring-tailed Possum.

**Microscopy Group — Third Wednesday**

Wednesday, 17th August. "Gadget Night."

Wednesday, 21st September. Dr R. Hamond. Past and present studies on the Harpacticoid Copepods.

Wednesday, 19th October. Mr J. Dawes. Development of microphotography.

# *Field Naturalists Club of Victoria*

Established 1880

Registered Office: FNCV, c/- National Herbarium, Birdwood Avenue, South Yarra, 3141.

**OBJECTS:** To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

*Patron:*
His Excellency Rear Admiral SIR BRIAN S. MURRAY, KCMG, AO.

**Key Office-Bearers 1983-1984**

*President*
Miss WENDY CLARK, 27 Rangeview Grove, North Balwyn, 3104 (859 8091 A.H.)
*Vice-President:*
*Hon. Secretary:* Mrs SHEILA HOUGHTON, 30 Golf Links Crescent, Dingley, 3172 (551 2708 A.H.)
*Hon. Treasurer:* Mr DAVID DUNN, 3 Allfrey Street, East Brighton, 3187 (578 5753)
*Subscription-Secretary:* Miss H. MALCOLM, c/- FNCV National Herbarium, Birdwood Avenue, South Yarra, 3141
*Editorial Material:* Forward to Ms J. U. PHILLIPS, National Museum of Vic., Russell St., Melbourne, 3000.
*Librarian:* Mrs JANE CALDER, c/- FNCV National Herbarium, Birdwood Avenue, South Yarra, 3141
*Excursion Secretary:* Miss MARIE ALLENDER, 19 Hawthorn Avenue, Caulfield, 3161 (527 2749)
*Book Sales Officer:* Mr D. E. McINNES, 129 Waverley Road, East Malvern, 3145 (211 2427)

**Group Secretaries**

*Botany:* Mr PETER CARWARDINE, 2a Victoria Road, Malvern, 3144 (509 0622 B.H. 211 8958 A.H.)
*Day Group:* Mrs F. L. GILLESPIE, 23 Wild Cherry Road, Carnegie 3163 (578 1879)
*Geology:* Mr TOM SAULT, c/- FNCV, National Herbarium, Birdwood Avenue, South Yarra, 3141
*Mammal Survey:* Mr LANCE WILLIAMS, 29 Erica Crescent, Heathmont, 3135 (879 1962 A.H.)
*Microscopical:* Mrs ELSIE GRAHAM, 147 Broadway, Reservoir, 3073 (469 2509)

**MEMBERSHIP**

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

**Subscription rates for 1983**

| | |
|---|---|
| Metropolitan | $15.00 |
| Joint Metropolitan | $18.00 |
| Country Members and Retired Persons | $12.00 |
| Joint Country and Joint Retired | $15.00 |
| Junior | $3.00 |
| Subscription to Victorian Naturalist | $13.00 |
| Overseas Subscription to Victorian Naturalist | $15.00 |
| Individual Journals | $2.20 |

All subscriptions should be made payable to the Field Naturalist Club of Victoria and posted to the Subscription Secretary.

Jenkin Buxton Printers Pty. Ltd. 113 ABBOTSFORD ST. WEST MELBOURNE 328 4774 329-7959

# The Victorian Naturalist

Vol. 100, No. 5
Sept./Oct.
1983

Published by the FIELD NATURALISTS CLUB OF VICTORIA
in which is incorporated the Microscopical Society of Victoria

Registered by Australia Post. Publication No. V.B.P. 1268

$2.20

## FNCV DIARY OF COMING EVENTS

## GENERAL MEETINGS

**Monday, 10th October, 8.00 p.m.**

Mr Donald Johnson, Bird life of Iowa.

Honorary membership will be awarded to Mr Thomas Byrne.

**Monday, 14th November, 8.00 p.m.**

Presentation of the Australian Natural History Medallion.

The Medallion address will be given by the winner, Mr Trevor Pescott, on 'Bird life and conservation in the Geelong area'.

**Monday, 12th December, 8.00 p.m.**

Dr Ian Bayly, Plankton of an Antarctic Fiord.

Honorary membership will be awarded to Mr W. H. Fulton.

**New Members — September/October General Meetings.**

*Metropolitan*

David Albrecht 46 Weeden Dve., Vermont Sth (botany)
W. Ashburner, 3/436 Belmore Rd., Box Hill Nth (botany)
Wayne Beauglehole, 218 Huntingdale Rd., Huntingdale
Mark Forsyth, 10 Leslie St., Richmond
Margaret McKenzie, 29/3-25 Hanover St., Fitzroy, (geology & botany)
Audrey Pittard, 17 Gwenda Ave, Canterbury, (day group)
Mary Williams, 1/40 Whitby St., West Brunswick, (marine biology & botany)

## FNCV EXCURSIONS

**Saturday-Sunday, 8-9th October.** V.F.N.C.A weekend at Ocean Grove, see last Naturalist

**Sunday, 6th November.** Labertouche. Leader: Wendy Clark. The coach will leave Batman Avenue at 9.30 a.m., fare $9.00, bring one meal and a snack. This year we are holding the November excursion on the first Sunday in November instead of Cup Day as so many members like to go away for the long weekend

**Sunday, 4th December.** Phillip Island. The coach will leave Batman Avenue at 9.15 a.m., or as near as possible, most trains and tram services will allow the earlier departure. If yours does not, please let the excursion secretary know. Fare $9.00, bring one meal and a snack.

**Thursday, 12th to Thursday, 19th January 1984.** King Island. The party will fly to Currie on Thursday morning where accommodation has been booked at the Boomerang Motel on a room only basis, cost for motel and airfare is $300. A bus will be chartered on the Island for day excursions and we hope to have some of the King Island Naturalists on some of these trips. A deposit of $50.00 should be paid to the excursion secretary when booking.

**Australia Day Weekend 1984.** The Snowy Range led by Dr Jim Willis and John Milligan.

The Snowy Range is a high plateau located between the Macalister and Wonnangatta rivers.

The country is generally above 1,500 metres and is interspersed with snow-grass plains and sub-alpine woodland. Vivid displays of alpine flora cover vast areas, and the scenery is magnificent.

The walks we propose are Mt Howitt, Mt Reynard and Bryces Gorge.

At these altitudes, blizzards are common (even in the Summer months), and those members intending to come along should be equipped accordingly.

Inquiries should be directed to John Milligan, 557 3509.

**Kingston's Tours** in co-operation with the Western Victorian Field Naturalists Clubs are running a 28 day camping Tanami Kimberley Pilbara Expedition departing Stawell 3rd June, 1984, tariff $835.00. Booking should be made with Kingston's Tours, 23 Wimmera St., Stawell, 3380, deposit $50.00. More information is available from the excursion secretary or detailed brochures from Kingston's Tours

## GROUP EXCURSIONS

All FNCV members are invited to attend Group Excursions.

**Mammal Survey Group.**

October, 8th-9th. Camp at Strathbogie Ranges.
October 29th-November 1st. CUP WEEKEND. Camp at West Wyperfeld.
November 26th-27th. Camp at Melton Mallee.
December 26th-January, 1st. To be announced.

**Botany Group.**

Saturday, 29th October. East Metcalf — Black Hill, Kyneton.
Saturday, 26th November. To be announced.

(Continued on inside back cover)

F.N.C.V.

# The Victorian Naturalist

Volume 100, Number 5

September/October, 1983
ISSN 0042-5184





*Cover illustration* — Ants (*Iridomyrmex* sp.) dispersing on *Acacia* seed at Wyperfeld National Park, Vic. See article p.188.

# An Introduction to Ants

By Alan N. Andersen*

Ants constitute a single taxonomic family, the Formicidae, and belong to the insect order Hymenoptera along with bees, wasps and sawflies. They are social insects organized into colonies; a colony typically includes an egg-laying queen, many adult workers, and the younger stages or brood (eggs, larvae and pupae). The ants commonly seen active on soil and vegetation are workers — sterile females whose function is to care for the queen and her brood. Most species are generalist predators and scavengers, feeding on a wide variety of prey and the carcasses of dead insects and other arthropods. Many also forage on vegetation for nectar and the honeydew secretions of homoptorous insects, and some feed on seeds collected from the ground. Most Australian ants live within chambers in the soil, or under rocks or logs. In forested areas many species nest inside rotted logs and some within cavities and hollow branches of trees.

Ants are one of the most abundant, diverse and important groups of insects. The estimated 20,000 species are distributed throughout all non-polar land regions, and are represented by at least $10^{15}$ individuals at any one time. In Australia, ants are particularly diverse and abundant, especially in our semi-arid areas, and are considered to be one of the most important groups of animals. The number of Australian species is not known because a large proportion have not yet been collected and described; however it is probably around 4000.

**Structure of a Worker Ant**

The body of a worker ant is divided into three main sections: the head, trunk and gaster (Fig. 1). The trunk and gaster are typically separated by a waist consisting of either a single segment (the petiole) or two segments (petiole and post-petiole), a feature that readily distinguishes ants from all other insects. (Ants discharge offensive fluids from the tip of their gaster — via a sting in some species and through an aperture in others, and the waist gives the gaster considerable flexibility of movement.) With a few exceptions, another distinguishing feature of ants is the possession of a pair of large metapleural glands which open on either side of the posterior portion of the trunk. This gland evidently secretes antibiotics which help prevent the invasion of nests by microorganisms.

Although the trunk and gaster appear to correspond to the thorax and abdomen of a typical insect, the propodeum is in fact an abdominal segment that has fused to the thorax, and the petiole and post-petiole are also modified abdominal segments.

The thorax of a worker ant is extremely simple compared with other Hymenoptera due to the reduction and fusion of various elements, so that only two major divisions (the pronotum and mesonotum) are recognized. The trunk and waist are extremely variable across species with respect to shape, pilosity, possession of spines or teeth, and sculpturing of the integument (Fig. 2).

The head has a pair of compound eyes, a pair of multisegmented antennae (which have a distinctive 'elbowed' appearance due to the marked elongation of the first segment) and toothed mandibles, as well as other mouthparts not shown in Fig. 1. The head and mandibles also show considerable variability (Fig. 3).

* School of Botany
University of Melbourne
Parkville Vic. 3052

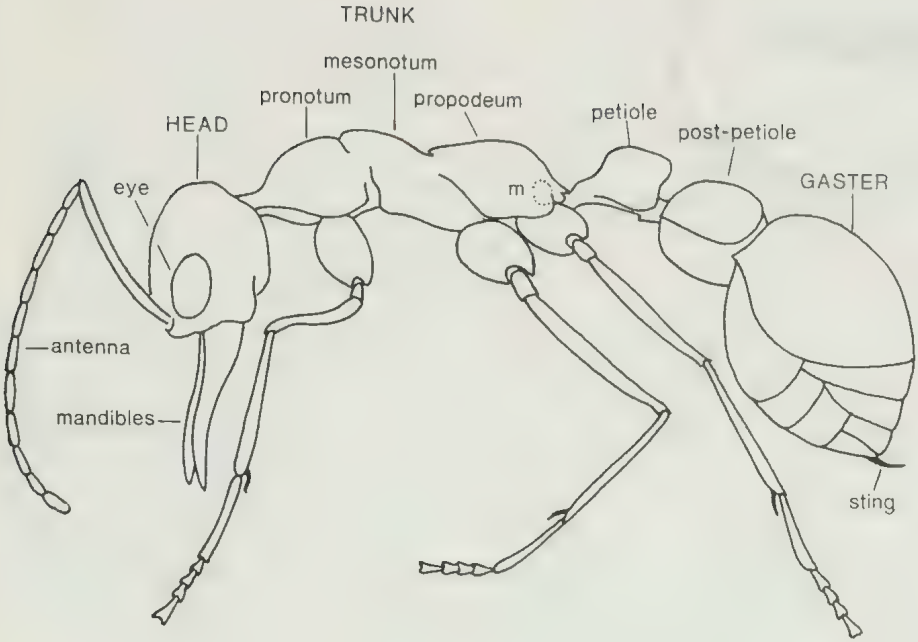



Fig. 1. Structure of a worker ant (*Myrmecia* sp.) m — opening of metapleural gland.

**Ant Castes**

A typical ant colony contains three basic castes (Fig. 4): two of these (queen and male) are fertile, and the third (worker) comprises sterile females. Unlike workers, queens and males have a 'normal' wasp-like trunk with wings and well-developed flight muscles (although the wings of the queen are deciduous). The head, eyes, antennae and mouthparts of the queen are all similar to those of the workers, although the gaster is larger due to her well developed ovaries and fat bodies. By contrast, males have relatively small heads and large compound eyes, reduced and in many cases functionless mandibles, and usually filiform (non-elbowed) antennae. The workers are sometimes divided into two or more sub-castes — majors, medias and minors. These sub-castes generally exhibit allometric growth, with the majors (often called soldiers) having disproportionately large heads and mandibles. Species which have only major and minor workers are said to be dimorphic, and those which also have intermediates, polymorphic; however most species are monomorphic. (Although species of *Pheidole* are generally dimorphic, that shown in Fig. 4 is polymorphic.) A wingless intermediate female caste (ergatogynes) occurs in some species. These may replace the true queen as the reproductive caste, a situation that is found with unusual frequency among Australian species.

The differences between male and female ants are genetically determined — males develop from unfertilized eggs and are therefore haploid, whereas females develop from fertilized eggs and are diploid (a situation found throughout the Hymenoptera and in some other insect groups). However the differences between the female castes (queens and workers) are phenotypic and probably involve interactions be-

Fig. 2. Trunk and waist of various Australian ants. A. *Myrmecia* sp; B. *Amblyopone australis;* C. *Rhytidoponera* sp; D. *Discothyrea* sp; E. *Bothroponera* sp; F. *Odontomachus* sp; G. *Solenopsis* sp; H. *Meranoplus* sp; I. *Crematogaster* sp; J. *Adlerzia* sp; K. *Podomyrma* sp; L. *Monomorium* sp; M. *Orectognathus clarki;* N. *Oligomyrmex* sp. (major); O. *Pheidole* sp. (major); P. *Cardiocondyla* sp; Q-S. *Chelaner* spp; T. *Tetramorium* sp; U. *Froggattella kirbyi;* V. *Tapinoma* sp; W-Y. *Iridomyrmex* spp; Z. *Stigmacros* sp; AA. *Prolasius* sp; BB. *Paratrechina* sp; CC. *Camponotus* sp; DD. *Calomyrmex* sp; EE. *Notoncus ectatommoides;* FF. *Polyrhachis* sp; GG. *Myrmecorhynchus* sp. (not to scale; adapted from Greenslade 1979).

tween pheromones, stored nutriment in the egg, and the composition of larval food.

Each of the different castes perform different tasks within the colony, a phenomenon termed caste polyethism. The males contribute almost nothing to the domestic workings (a familiar situation to many of us) and their only task is to inseminate queens, after which they soon die. They have been quaintly referred to as "flying sperm dispensers launched by the colony". The queen also does little domestic work (except for early on in the life of the colony) and is virtually little more than an egg-producing machine. All the work of the colony is performed by the workers — they excavate and clean the nest, they collect the food, feed and care for the queen, males and immature stages, and they defend the nest from attack. In polymorphic species there is a further division of labour amongst the worker sub-castes, with the soldiers spending most of their

time guarding the nest and the smaller workers doing most of the foraging.

**Colony Reproduction**

The life of a colony begins when a newly inseminated queen alights from her mating flight, loses her wings and excavates a small chamber (usually in the soil or under a stone or log) where she lays a small number of eggs. These hatch into legless, grub-like larvae which she feeds and cares for. The larvae eventually pupate (often after spinning cocoons) and emerge as adult workers. This form of life-cycle, involving a dramatic metamorphosis from an immature grub-like stage into an adult, is called holometabolistic and is shared by all other 'higher' insects including flies, beetles, butterflies and moths. In the other, more primitive, form of insect life-cycle (hemimetabolistic, found for example in true bugs, dragonflies and grasshoppers) a miniature, wingless version of the adult hatches from the egg, and becomes increasingly adult-like with successive moults.

It can take up to two years for a queen to rear her first brood of workers, and in most species she remains in the chamber during this time, relying on the metabolism of her fat reserves and flight muscles to sustain herself and her brood. This is known as claustral colony-founding behaviour. In the more primitive species (for example the bull ants and jumper ants of the genus *Myrmecia)* the queen periodically leaves the chamber in search of food, but in doing so exposes herself to the risk of predation. After the emergence of the first adult workers the queen continues to lay eggs, but the workers take over all the other work: they enlarge the nest, forage for food, feed and care for the queen and her subsequent brood, and defend the colony from intruders (mostly other ants). During the next few years the colony continues to grow and typically contains between one hundred and several thousand workers.

When the colony is mature, winged reproductive males and females are produced and collect in the nest. These are released at a certain time of the year (often during spring) that is fixed for each species, and generally results in a mass nuptial flight during which mating occurs. The fertilized females then go on to begin new colonies and the males soon die. Meanwhile the original queen continues to produce eggs until she eventually dies. In some cases she is then replaced by another queen, but normally the colony dies out altogether. This whole colony life-cycle averages about ten years.

Although the majority of species conform to this general pattern of colony reproduction, there are many modifications — for example, many species produce polygynous colonies which contain several queens. Other species show more extreme deviations from the norm. These include the so called 'social parasites' which can function only by exploiting the services of other colonies. Of particular interest are 'slave-making' ants (not known to occur in Australia) which periodically raid other nests to maintain their contingents of slaves which serve the 'master' colony as if it were their own.

**The Importance and Success of Ants**

Ants are an important component of most terrestrial ecosystems and in Australia this is particularly so due to their ubiquity, sheer abundance and high rates of activity. As voracious predators and scavengers they increase the rate of energy turnover, influence the distribution of both prey and competitor species, and increase community complexity and stability. Ants form particularly close associations with plants and, through a wide variety of habits (such as the tending of aphid and coccid bugs, protection from harmful insects, seed predation, and seed dispersal) exert a powerful influence on vegetation.

Ants also play an important role in the formation, turnover, infiltration, aeration and nutrient enrichment of soils. Ants do not appear to be a widespread source of food, although they are an important component of the diets of some members of most animal groups (including mammals, birds, reptiles, amphibians, spiders and other invertebrates).

Although the activities of ants are generally beneficial in an ecological sense, they sometimes have economic costs. Many aphid and coccid bugs are a serious threat to crops and orchards only when tended by ants. Harvesting species often interfere with agricultural and forestry seeding operations. Some ants are also of considerable nuisance value, including the meat ant *(Iridomyrmex purpureus)* and introduced Argentine ant *(I. humilis)* which frequently invade factories and homes, and the powerfully stinging bull ants and jumper ants *(Myrmecia* spp.) which are notorious pests of the Australian bush.

Their abundance, distribution, diversity of ecological adaptations, and importance make ants one of the most successful of all animal groups. What is the secret to their success? A major reason, of course, is the possession of a sterile worker caste produced by the queen to help her successfully rear offspring. This is really quite a neat trick in an evolutionary sense — natural selection has favoured queens which produce workers to help her reproduce; and, since the workers are sterile and therefore cannot evolve individual selfishness, natural selection operates only on their contribution to the reproductive success of

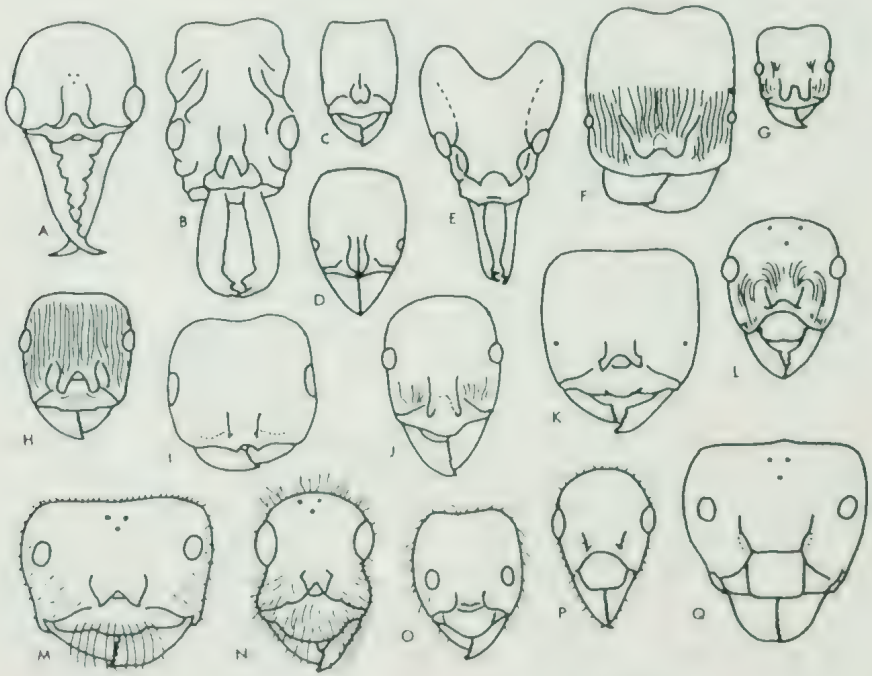



Fig. 3. Heads of various Australian ants. A. *Myrmecia* sp; B. *Odontomachus* sp; C. *Ponera* sp; D. *Trachymesopus rufonitor*; E. *Orectognathus clarki*; F. *Pheidole* sp. (major); G. *Pheidole* sp. (minor); H. *Podomyrma* sp; I. *Chelaner* sp; J. *Aphaenogaster* sp; K. *Acropyga* sp; L. *Notoncus hickmani*; M-N. *Melophorus* spp; O. *Paratrechina* sp; P. *Myrmecorhynchus* sp. (minor); Q. *Myrmecorhynchus* sp. (major) (not to scale; adapted from Greenslade 1979).

the queen. This has resulted in extreme social complexity, cohesion and individual altruism.

However, a sterile worker caste also occurs in a number of other insect groups, notably the termites and social bees and wasps — why are ants the pre-eminent social insect? Firstly, ants have the ability to eat a wide range of food items, including prey, and are not bound to a restricted diet like termites (cellullose) and bees (nectar and pollen). Secondly, the worker caste of ants is wingless, enabling them to forage deeply into soil, litter and plant crevices. Finally, with the aid of special antibiotic secretions ants are able to nest in soil and leaf mould and therefore have direct access to this extremely energy-rich microhabitat.

**Identification of Ants**

Although the majority of Australian ants cannot be confidently named at the species level (due to our very large number of species, many of which remain uncollected or undescribed), our genera are mostly well-defined and usually can be recognized without resort to difficult taxonomic characters. Most can be readily identified by reference to the trunk and waist in profile (Fig. 2) and to features of the head and mandibles in front view (Fig. 3).

Ants are divided into about 10 sub-families (depending on the classification followed) and each of these have at least some representatives in Australia. A simplified key to the sub-families of Australian ants using worker characters is given below. The sub-families that are not well-represented have been omitted. These include the DORYLINAE (army ants of the genus *Aenictus)* and PSEUDOMYRMECINAE *(Tetraponera)* which are represented by a few species mostly in the tropical north, and NOTHOMYRMECIINAE represented by the primitive *Nothomyrmecia macrops* which in recent times has only been recorded from Eyre Peninsula, S.A.

**Key to Common Sub-families**

1. Waist consisting of petiole and post-petiole (e.g. Figs.1; 2A, G-T).....2
Waist consisting of petiole only (e.g. Figs. 2 B-F, U-GG).....3
2. Larger species (usually > 8mm) almost always with long, slender mandibles and very large eyes *(Myrmecia,* Figs. 1, 2A, 3A).....MYRMECIINAE
Mostly smaller species; eyes small; mandibles usually triangular (e.g. Figs. 2G-T; 3E-J).....MYRMICINAE
3. Sting present; petiole generally broad in profile (e.g. Figs. 2B,C,E) .....PONERINAE
Sting absent; petiole generally narrow in profile (e.g. Figs. 2U-GG).....4
4. Defensive spray discharged through a circular opening which forms a cone at the apex of the gaster and is often surmounted by a circlet of hairs .....FORMICINAE
Defensive fluid discharged through an obscure slit; often with a characteristic 'ant' odour when handled .....DOLICHODERINAE

The MYRMECIINAE is represented by a single genus, *Myrmecia* (the bull ants and jumper ants), which comprises approximately 100 species, all restricted to Australia except for a single species in New Caledonia. Species of *Myrmecia* are found in most climatic zones, but are particularly abundant in sclerophyllous open forests and woodlands of southern Australia, where most sites support several species. Along with *Nothomyrmecia* and the Australian ponerine *Amblyopone* (Fig. 2B), they are believed to be among the most primitive of all living ants.

The PONERINAE is well-developed in Australia but its species are mostly inconspicuous and little-known. This is because many nest under stones or logs and are cryptic predators foraging in soil

and litter. However species of *Rhytidoponera* — medium to large (5-13 mm), heavily sculptured ants recognized by a 'tooth' at the inferior angles of the pronotum (Fig. 2C), are notable exceptions. Most forage on the ground for prey and carrion, and some appear to be important seed-harvesters, an unusual feeding habit in this sub-family.

The MYRMICINAE is an extremely diverse group found in all habitats. It contains most of our important seed-harvesting genera *(Pheidole,* Figs. 20, 3 F-G, 4; *Chelaner,* Figs. 2Q-S; *Monomorium,* Fig. 2L; and *Meranoplus,* Fig. 2H) and includes the peculiar tribe DACETINI whose species have a reduced number (4-7) of antennal segments and often unusual waist and mandibles e.g. *Orectognathus clarki,* Figs. 2M, 3E). Species of *Aphaenogaster* (Fig. 3J) form conspicuous craters around their large (1.5 cm diam.) nest entrance holes and are particularly common in sandy soils. They are light-brown, slender, medium-sized (ca. 5 mm) ants usually active at night. *Crematogaster* (Fig. 2I) is a widespread and distinctive myrmicine genus, recognized by the pointed gaster (attached dorsally to the post-petiole) which is raised when alarmed. Red-brown species with black gasters are commonly found on vegetation where they collect the honey-dew secretions of homoptorous insects.

The DOLICHODERINAE includes *Iridomyrmex* (Fig. 2W-Y), which is probably the most widespread and abundant genus of Australian ants. Its hundreds of species are distributed throughout all habitats and all climatic

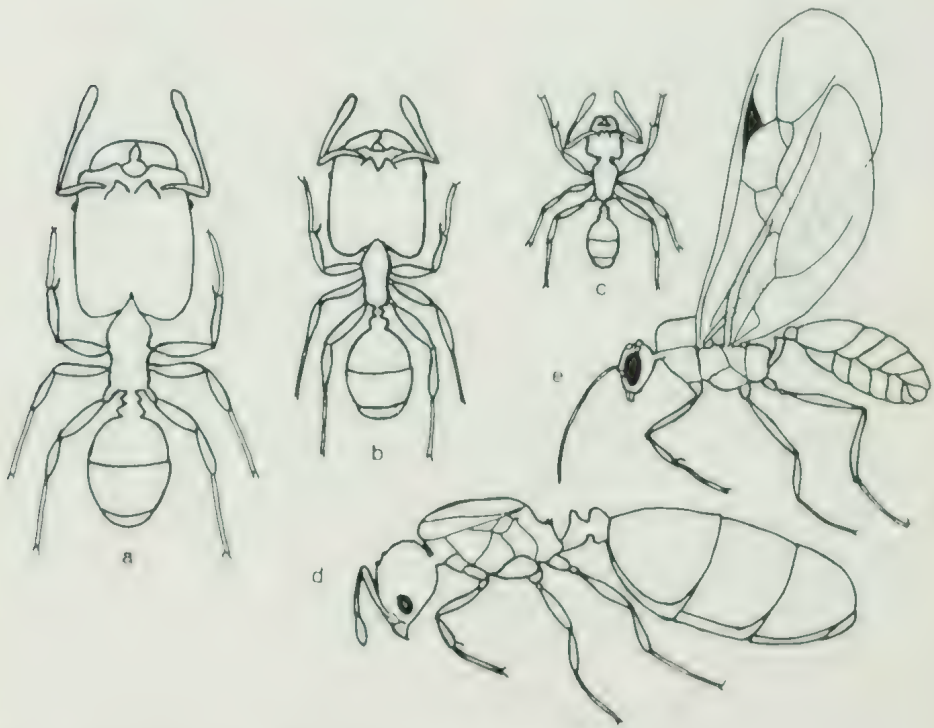



Fig. 4. Castes of *Pheidole* sp. a. major worker (soldier); b. media worker; c. minor worker; d. queen; e. male (adapted from Wheeler 1910)

zones and are prominent, if not dominant, components of the ant faunas of most sites. Most species are small to medium-sized (2-4 mm) and dark in colour, although nocturnal species are often pale. Species from mesic areas tend to have a rather prominent meso and pronotum (distinct from the propodeum) and heart-shaped heads with eyes positioned in the lower half. Those from xeric areas are often slender, fast-moving species with larger eyes situated at or above the middle of the head. The large (ca. 10 mm), diurnally active meat ants *(I. purpureus* and related species) form massive colonies on non-sandy soils throughout inland Australia, where they are often dominant members of the invertebrate fauna. Species of *Iridomyrmex* appear to be an important part of the diets of specialist ant-feeding animals such as the Thorny Devil lizard *(Moloch horridus),* echidna *(Tachyglossus aculeatus)* and Corroboree Frog *(Pseudophryne corroboree).*

The FORMICINAE includes *Camponotus* and *Melophorus* (both with highly polymorphic species) which, along with *Iridomyrmex,* are among Australia's most abundant and diverse genera. Species of *Camponotus* (which include the so-called 'sugar ants') are medium-sized to large (major workers up to 2 cm in length) and represent an enormous diversity of morphology, colour and habits. They are found in all habitats and all climatic zones, and are particularly conspicuous at night during warmer months. Species of *Melophorus* are also extremely diverse, but are generally smaller than *Camponotus* (majors up to 1 cm., but usually less than 5 mm). They can be recognized by the presence of J-shaped hairs on the mentum (just above the mandibles on the underside of the head) and very often have a characteristic 'moustache' of long, curved hairs on the clypeus (Fig. 3M). They are particularly successful in arid and semi-arid habitats, where it is common to find more than a dozen species at a single site. Many species can tolerate extremely high temperatures and are frequently the only ants active during the middle of hot summer days. Whereas many species of *Camponotus* forage and even nest in vegetation, nearly all *Melophorus* restrict their foraging to the ground. Other common and distinctive formicine genera are: *Stigmacros* (Fig. 2Z), small ants (1-3 mm) with 11-segmented antennae and a small tooth on either side of the propodeum; *Notoncus* (Figs. 2EE, 3L), medium-sized ants (3-5 mm), pronotum and mesonotum prominent, often with conspicuous processes; and *Polyrhachis* (Fig. 2FF), largish (5-12 mm) heavily-built black ants (legs or gaster sometimes paler) with prominent spines on the propodeum and petiole, often found on vegetation at night during warmer months.

**Acknowledgements**

I wish to thank Dr R. W. Taylor and Dr P. J. M. Greenslade for their helpful comments on earlier drafts of this paper. The S.A. Museum Board granted permission for the use of figures from *A guide to ants of South Australia.*

REFERENCES

Brown, W. L. & Taylor, R. W., (1970). Hymenoptera; superfamily Formicoidea. In: *The Insects of Australia.* Division of Entomology, CSIRO, Melbourne.

Dumpert, K., (1978). *The social biology of ants.* Pitman Publishing Ltd., London.

Greenslade, P. J. M., (1979). *A guide to ants of South Australia.* South Australian Museum, Adelaide.

Sudd, J. H. (1967). *An introduction to the behaviour of ants.* Arnold, London.

Wheeler, W. M., (1910). *Ants: their structure, development and behaviour.* Columbia University Press, N.Y.

Wilson, E. O. (1971). *The insect societies.* Belknap Press, Cambridge, Mass.

## We are now on Computer

Following a Council decision in May the Club's membership records have been put on a computer, and the July–August issue of *The Victorian Naturalist* was the first to be sent out with computer produced mailing labels. We are optimistic that this will produce a more efficient and economical service than the previous method.

Membership categories have been coded, and this symbol appears on the address label at the top left-hand corner, above the name. The coding is as follows, and we would ask members to check this symbol for accuracy. Any queries should be addressed to the Subscription Secretary, c/- FNCV, National Herbarium, Birdwood Avenue, South Yarra, 3141.

| | |
|---|---|
| Metropolitan (03 telephone area) | M |
| Joint Metropolitan | J |
| Country/Interstate | C |
| Joint Country/Interstate | K |
| Retired | R |
| Joint Retired | T |
| Student (full-time) | F |
| Honorary | H |
| Life | L |
| Subscriber | S |
| Overseas Subscriber | O |
| Affiliated Club | A |
| Subscriber Club | B |

Members should note that only one name appears on the address label, but the symbol J, K or T indicates that this is a joint membership.

Sheila Houghton
Hon. Secretary

---

# Ants on Manna Gum Saplings

By T. Sault*

On many occasions while walking along bush tracks in the Upper Big River valley I have noticed a species of ant about 12mm long with a green and brown abdomen, congregating on the stems of young manna gums. They remain motionless if not disturbed, as though they are resting. As there had been no rain each time I observed them, they were not escaping a flooded nest. There were no scale insects on the gum to produce manna, so the only logical explanation I can come up with is that they were extracting the sugary sap or a residue on the surface. This is the only species of ant I have observed doing this.

I have also noticed where wombats have excavated shallow roots of manna gum for up to 7 or 8 metres of their length and chewed off the uppermost bark, perhaps for the same reason as the ants. It seems, therefore, that the manna gum may be the most predated eucalypt because of its sugary sap.

* 13 The Avenue, West Rosebud, Victoria 3940

# Pollination and Pollinarium of *Dipodium punctatum* (Sm.) R. Br.

By Peter Bernhardt† and Pamela Burns-Balogh*

*Dipodium punctatum*, the Hyacinth Orchid, is a common leafless saprophyte and one of the few orchid species found flowering over the summer months in Victoria (Willis 1978). Despite its wide distribution throughout the state and its large colourful flowers, virtually nothing is known of its floral biology. We present our recent observations in the hope it will encourage further field studies on this attractive plant.

A clump of six mature shoots of *D. punctatum* was found along a picnic trail off the Serra Road track in the Grampians State Forest in early January 1983. Five shoots had open flowers but one shoot remained in bud.

On 12/1/83 at 1:30 pm a native bee entered the site and was observed visiting the open flowers of *D. punctatum*. The bee visited the flowers on three stalks before it was captured. This insect was identified as a female, *Chalicodoma (Hackeriapis) derelicta* Cockerell (Megachilidae) by Ms Judith King, of the Department of Entomology at the Univ. of Queensland at Santa Lucia. The bee carried a viscidium of *D. punctatum* just above its antennae but below the middle occellus (Figure 1). However, the pollen of other species were found on the bee's body. Stylidiaceae pollen (probably *Stylidium graminifolium* Swart, as it was still in flower in the Grampians) was densely deposited between the juncture of the head and the thorax (Figures 1 and 2). The pollen of *Eucalyptus* sp. and *Bursaria spinosa* Cav. were found in the scopae of the hind legs and on the underside of the abdomen (Figure 3). Although some Australian orchids offer food hairs or a "pseudopollen" of sloughed petal cells (Jones 1981) none were found on the body of *C. derelicta*.

This is the first time that a member of the genus *Chalicodoma* has been observed visiting orchid flowers and carrying a viscidium. *Chalicodoma derelicta* has been recorded previously on the bushpea genera *Jacksonia* and *Dilwynia* (Papilionaceae) and on *Wahlenbergia* (Campanulaceae) by Ms J. King. Armstrong (1979) reviews observations of *Chalicodoma* species foraging on the flowers of Myrtaceae, Papilionaceae and Proteaceae.

The second author examined the pollen masses (pollinarium) with a Scanning Electron Microscope at the Smithsonian Institute in Washington, D.C. Each pollinarium was composed of four structures (fig. 4). There were four *pollinia* fused in two sets. The pollen grains within each pollinia were clustered in groups of four (tetrads). Each tetrad was united to other tetrads by a common wall to form hard, compact masses. There were two *caudicles*, one for each pollinia set, that served to attach the pollinia sets to the stipe. The caudicles consisted of elastoviscin produced by degenerative, sporogenous cells within the anther. The *stipe* was two branched (one branch for each caudicle) which served to attach the viscidium to the caudicle. Unlike these caudicles, the stipe was cellular. Finally, the *viscidium* ("sticky pad") adhered to the bee after the pollinarium was removed from the anther. The viscidium was shoe-like, rounded at the apex, blunt at its base and cellular like its stipe (Figure 5).

The four pollinia and their two

† Plant Cell Biology Research Centre, C/o School of Botany, Univ. of Melbourne, Parkville, Vic. 3052.

* Dept. of Botany, NHB 166. Smithsonian Institution, Washington, D.C. 20650.

caudicles were derived from the orchid flower's solitary anther. In contrast, the viscidium and its stipe were derived from the rostellum (Dressler 1981).

Although *D. punctatum* is a terrestrial orchid its pollinia had little in common with the majority of Australian ground orchids placed in the tribe, Diuridae *(sensu* Dressler 1981). For example, the pollinia of *Pterostylis, Diuris* and *Thelymitra* are soft and granulate. Their tetrads are threaded together by cohesion strands and not by common walls. *Caladenia, Eriochilus* and *Glossodia* produce granulate pollen too but these grains are separate and never united as tetrads. The hard pollinia of *D. punctatum* are composed of tetrads united by common walls and, therefore, most closely resembled members of the tropical-subtropical Tribe, Vandeae, in the subtribe, Cyrtopodiinae, such as *Eulophia* and *Cymbidium* (Dressler 1981).

This story did not have a happy ending. It was the intention of the first author to return to the Serra Road site over a seven day period to collect more insects that may have pollinated *D. punctatum*. However, the following day the author found that someone had found the plants and picked *every* flowering stalk, uprooting two!

**Acknowledgements**

The authors would like to thank Dr Susan Duigan for analysis of the Stylidiaceae pollen and Ms J. King for identifying the bee. Funding was provided by the Australian Department of Education (CPPER). This article is dedicated to the memory of Mrs Edith Coleman whose observations on pollination remain the touchstone for those interested in Australian terrestrial orchids.


FIG. 1 The head of *Chalicodoma derelicta* bearing the viscidium of *Dipodium punctatum* and the pollen of a member of the Stylidiaceae × 15. A = antenna; O = middle ocellus; SY = Stylidiaceae pollen; V = viscidium

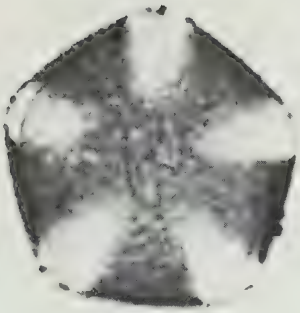


Fig. 2. Pollen grain of Stylidiaceae × 350. Removed from the juncture of the head and thorax.


Fig. 4. Scanning Electron Micrograph of the pollinarium of *D. punctatum* × 21. C = caudicle; P = two pollinia composing one set; ST = stipe; V = viscidium.

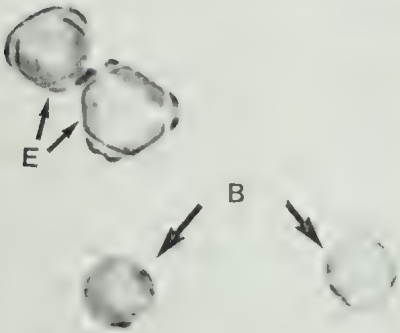



Fig. 3. Pollen of *Eucalyptus* sp. (E) and *Bursaria spinosa* (B) × 192 taken from the scopal hairs of the hind legs.


Fig. 5. SEM of the base of the pollinarium showing how the branches of the stipe (ST) emerge from the shoe-like viscidium (V) × 55.

REFERENCES

Armstrong, J. A., (1979). Biotic pollination mechanisms in the Australian flora — a review. *New Zealand J. of Bot. 17:* 467-508.

Dressler, R. L. (1981). *The Orchids.* Harvard Univ. Press, Cambridge, Massachusetts and London, England.

Jones, D. L. (1981). The pollination of selected Australian orchids. 40-43, *In,* Proceedings of The Orchid Symposium Held As a Satellite Function of the 13th International Botanical Congress, Sydney, Australia 1981. Editors Lawler, L. and Kerr, R. D. Harbour Press, Sydney.

Willis, J. H. (1978). *A Handbook to Plants in Victoria. I. Monocotyledones.* Melbourne Univ. Press.

## Australian Natural History Medallion Fund

Amount on hand January 1983, $1,958.50
Mrs Ellen Lyndon, 3rd Donation, $24.00

# Ancient Seaway between Geelong Harbour and Bass Strait, Victoria

By Edmund D. Gill* and A. C. Collins**

Between the pleasant hills of Geelong and the rise of the Bellarine Peninsula lies the Moolap Lowland. This flat extends from Corio Bay through the Reedy Lake and Lake Connewarre area to Bass Strait. Its extreme flatness, low elevation (7 m), and very fine oxidized (yellow) sediments must all be explained in any theory of its origin.

Across the southern end of the lowland is a ridge of basalt rising to over 15 m, which has forced the Barwon River far to the east to debouch through the narrow gap between the basalt (as seen at Barwon Heads) and the Bellarine high land. The Moolap Lowland has been a puzzle for a long time, as is shown by the different accounts written of it, and the contrasting geological maps drawn. New data help to define the three events that dominate its later geological history (Late Pliocene to present).

**Buried Valley**

Bores at the Cheetham salt works proved over 9 m (not penetrated) of river sediments under a basalt flow that reaches 23.8 m below the surface (late G. B. Hope pers. comm. 1954). The Pollocksford Basalt (Coulson 1977) flowed down the bed of the ancestral Barwon River which reached present sea level about 25 km from Barwon Heads, and continued down to St. Albans where there is a quarry in this basalt. A bore at the Barwon Heads Golf Club penetrated nearly 20 m of calcarenite without reaching the base (Coulson 1936). Near the Lower Breakwater, a bore penetrated over 19 m of soft Quaternary sediments from a surface close to sea level.

**Three Rivers of Molten Lava**

Three lava flows contributed to the filling of the ancient Moolap Valley. The Pollocksford flow mentioned above has been dated 2.1 million years by radioactivity. In this Late Pliocene time, sea level was low for a considerable period, permitting a valley to be cut well below present sea level (Vail and Hardenbol 1979). The lava flow across the southern end of the Moolap Lowland is a different kind of basalt, and Coulson (1977) has traced it to Mt Duneed. A third kind of basalt is that in the salt works bore, in bores for the foundations of the CSIRO Animal Health Laboratory, and the basalt under the Botanic Gardens nearby. If this basalt is the same as that forming the high valley walls of the Barwon River (as mapped by Coulson), then it is older than the Pollocksford Basalt which forms the valley floor. Degree of weathering supports this dating.

**Two Marine Invasions**

In the Last Interglacial period, 125,000 years ago, the sea rose to 7 m higher than now. This sea level peak was dated at Port Fairy by the uranium/thorium method (Valentine 1965). The same date has been obtained in many parts of the world. As the summit of the Moolap Lowland is about 7 m, marine fossils have long been sought to prove that this is a seaway of that period. As a result of the recent drought and new developments in land use, many water holes have been excavated, and these have revealed seven localities with fossils between 4 and 7 m above sea level (Fig.

* 1/47 Wattle Valley Road, Canterbury, Victoria 3126
** 9 Warwick Street, Herne Hill, Geelong, Victoria 3218

1). These prove that a marine invasion occurred, forming a seaway between Corio Bay and Bass Strait.

A second marine invasion occurred about 6000 years ago, when the sea reached about 2 m above present sea level. These sediments are unoxidized, and can be dated by radiocarbon methods.

**Last Interglacial Marine Invasion**

The seven sites (Fig. 1) demonstrating the older marine invasion are:

**1. Marshalltown.** In the angle of Charlemont Road east of Sparrovale Road, the spoil from a water hole yielded three estuarine molluscs in yellow clayey silt, viz. *Anadara trapezia, Polinices sordidus* and *Katelysia rhytiphora.*

**2. Moolap.** Where the ALCOA power line crosses Townsend Road west of Moolap Station Road, the excavation for the footings of a new pylon yielded from the same yellow clayey silt *Anadara trapezia, Polinices conicus, Katelysia rhytiphora, Ostrea sinuata, Velacumantus australis, Hormomya erosa, Austrocochlea concamerata,* and *Bembicium auratum.* This formation is the Fishermens Bend Silt, first described from the Yarra Delta at Melbourne (Gill 1962, 1971).

**3. Whitehorse Road.** A large water storage on the east side 0.65 km south of the Bellarine Highway yielded *Anadara trapezia, Polinices conicus, Velacumantus australis, Hormomya erosa, Notospisula parva,* and *Parcanassa burchardi.*

**4. O'Halloran Road.** On the north side a water storage yielded *Anadara trapezia, Polinices incei, Katelysia rhytiphora, Ostrea sinuata, Velacumantus australis* and *Notospisula parva.* While shells from the other sites were from the spoil, the lowest in this site appeared to be in place. Over the shell bed at sites 4 and 5 is a sandy colluvium washed from the high area (Moorabool Viaduct Formation) to the east.

**5. Opposite Como Road.** A little further south, on the west side of Melaleuca Road, opposite Como Road, a drain leads west to a large water storage with *Anadara trapezia, Polinices sordidus, Katelysia rhytiphora, Velecumantus australis,* and *Notospisula parva;* also some scraps of *Ostrea* or *Hormomya.*

**6. Fishermens Point.** On the west side is a minor point of basalt, over which is a soil mixed with sand derived from the Moorabool Viaduct Formation (shown in a new water hole). The basalt is not as widespread as shown in Coulson's 1936 map and the Geological Survey map. In the newly ploughed field were numerous shells and shell fragments. The shells were not limited to edible kinds and sizes as in the middens, but ranged from a few millimetres to *Fasciolaria, Anadara trapezia* and *Katelysia rhytiphora,* so characteristic of the other sites, are present here also. The scarp east of sites 3 to 6, marked as a probable fault in the Geological Survey Map, is the degraded cliff of the Last Interglacial sea that laid down these sediments of the Fishermens Bend Silt. The sediments are fine because they are laid down in the lee of the Bellarine Peninsula and basalt flows.

**7. Tait Point, south of Fishermens Point.** A water hole excavated on the east side of Lake Road about 350 m south of the shore at Tait Point is about 5 m deep. Mr Ken Bell kindly informed us of this site, where he and Mr Robert Burn in 1973 found *Anadara trapezia, Katelysia rhytiphora, Ostrea sinuata* and *Zeacumantus diemenensis.* Shells are still available in the spoil. Waves of the 7 m sea cut a cliff in the colluvium above the basalt, and shells collected on the platform so excavated. Upon retreat of the sea colluvium buried the site, but the water hole excavation reached down to it. No doubt there are many places like this where colluvium hides the Last Interglacial shore.

The quiet water sediments and fossils of the above seven sites of the


Fig. 1. Map of the Moolap Lowland area, Victoria, Australia.

Fishermens Bend Silt contrast with the open ocean high energy fossils and calcareous sands described from Black Rock nearby (Gill and Alsop 1983). The formation is Port Fairy Calcarenite.

## The Dry Period

Clayey sediments are difficult to oxidize because water departs so slowly from them that the air seldom enters. It is remarkable in the sites described that

the sediments are so deeply and throughly oxidized. This is attributed to a dry period of 21,000 to 8,000 years ago when sea level was low, and these sediments were well dried out (Bowler et al. 1976, Gill 1978). At present lime does not accumulate in the subsoil here, but it did then.

**Holocene Marine Invasion**

After depositing the Fishermens Bend Silt and the Port Fairy Calcarenite the sea retreated so far as to bare most of Bass Strait. The lowest sea level was 20,000 to 18,000 years ago, after which it rose rapidly to reach a peak of about +2 m about 6,000 years ago (Gill and Lang 1982). This higher sea level penetrated Lake Connewarre and Reedy Lake, leaving extensive shell beds that rise above present sea level. For example, at the west end of O'Halloran Road there is a terrace with estuarine shells cut into the Fishermens Bend Silt wherein further east is the water hole with last Interglacial fossils (Site 4). Similarly, the waters of the Holocene invasion covered the salt pan flats of Corio Bay and extended up Hovell Creek. This shell bed was exposed when the second carriage way of the Princes Highway was built there. Marine boring shells had bored the freshwater limestone, over which was a Holocene shell bed that dated 5620 ± 90 years B.P. (NZ-279) (Gill 1972).

**Earth Movements**

Because the 7 m Last Interglacial deposits of the Moolap Lowland are at the same level as those on the very stable Warrnambool coast (where the bedrock is Miocene horizontal marine Port Campbell Limestone), it can be inferred that there have been no measurable earth movements in the Moolap area for the past 125,000 years. This means that the Holocene shell beds are likewise undisturbed. The latest earth movements of which we have found evidence is at Point Henry where the lacustrine clays dip north at 2-5°.

REFERENCES


Bowler, J. M., Hope, G. S., Jennings, J. N., Singh, G., and Walker, D., (1976). Late Quaternary climates of Australia and New Guinea. *Quat. Res. 6:* 369-394.

Coulson, A., (1936). Geological notes on Lake Connewarre, near Geelong. *Proc. R. Soc. Vict. 48:* 1-10.

Coulson, A., (1977). Age-relationships of Newer Basalts in the Geelong district, Victoria. *Proc. R. Soc. Vict. 89:* 159-165.

Gill, E. D. et al., (1962). ANZAAS Committee for the investigation of Quaternary strandline changes report *Aust. J. Sci. 25:* 202-205.

Gill, E. D., (1971). The far-reaching effects of Quaternary sea level changes on the flat continent of Australia. *Proc. R. Soc. Vict. 84:* 188-205.

Gill, E. D., (1972). Emerged marine shell beds near Geelong, Victoria, Australia, with marine shells bored into freshwater limestone. *Vic. Naturalist 89:* 315-319.

Gill, E. D., (1978). Palaeoecological changes in Victoria and Bass Strait as a backdrop for the marsupial megafauna and aboriginal colonization. *The Artefact 3:* 67-75.

Gill, E. D. and Alsop, P. F. B., (1983). Radiocarbon dating of coastal sand at Thirteenth Beach, west of Barwon Heads, Victoria. *Vic. Naturalist 100:* 76-79.

Gill, E. D., and Lang, J. G., (1982). The peak of the Flandrian Transgression in Victoria, S. E. Australia — fauna and sea level changes. *Proc. R. Soc. Vict. 94:* 23-34.

Vail, P. R. and Hardenbol, J., (1979). Sea-level changes during the Tertiary. *Oceanus 22(3):* 71-79.

Valentine, J. W., (1965). Quaternary mollusca from Port Fairy, Victoria, Australia, and their palaeoecological implications. *Proc. R. Soc. Vict. 78:* 15-73.

# Extension of Range of the Eastern Grey Kangaroo, *Macropus giganteus*, in Victoria

By G. M. Coulson[1] and C. Hutchinson[2]

**Identification and Distribution**

Both the Eastern Grey Kangaroo, *Macropus giganteus*, and the Western Grey Kangaroo, *M. fuliginosus*, occur in Victoria, but data on the distribution of the two species are inadequate. The species are morphologically similar and were first distinguished by Kirsch and Poole (1972) on the basis of reproductive parameters and serum protein polymorphisms. However, with experience they can be reliably distinguished in the field by coat colour: silver-grey to brown in the Eastern Grey Kangaroo; darker brown (never grey) with very dark forehead and ears in the Western Grey Kangaroo.

Following the taxonomic separation of the two species there were difficulties in identifying grey kangaroos sighted in the field, and faunal surveys tended to pool all sightings of grey kangaroos (e.g. Hampton *et al.*, 1982). The distribution of the two species in south-eastern Australia, based on examination of museum specimens (Poole 1977) suggested that there was a narrow zone of sympatry in Victoria (Fig. 1). Extensions of range have since been recorded in New South Wales and Victoria (Fig. 1).

**Extension of Range**

This paper reports a westward extension of range of some 50 km of the Eastern Grey Kangaroo in Victoria. A large adult male was shot in July 1982 about 27 km north of Rainbow in north-western Victoria within a few metres of the 142nd Meridian (35°40'S, 142°00'E) (Fig. 1). Its smaller but similarly-coloured companion escaped. The skull was lodged with the National Museum of Victoria (Registration No. C25769) and the skin was forwarded to CSIRO Division of Wildlife Research where the identification was confirmed as *M. giganteus*. The tanned skin has been retained by C. Hutchinson.

The specimen was collected on private land near Lake Werrebean, between Wyperfeld National Park to the north and abutting Albacutya Regional Park to the south. The predominant landforms in the area are level lakebeds and stable sandrises with interdune swales. River red gum, *Eucalyptus camaldulensis*, and Black box, *E. largiflorens*, form a woodland or open forest in the swales which are occasionally inundated by floodwaters; pure stands of river red gum fringe the larger lakebeds. The lakebeds support native and introduced grasses and a dense growth of burr medic, *Medicago polymorpha*, which appears to be an important food source for local kangaroos. The dominant vegetation of the sandy rises include slender cypress pine, *Callitris preissii*, scrub pine, *C. verrucosa*, buloke, *Casuarina leuhmannii*, sugarwood, *Myoporum platycarpum*, yellow mallee, *E. incrassata*, red mallee, *E. foecunda*, and Quorn mallee, *E. porosa*. These species form an open forest or open shrubland with a very sparse ground cover.

The property supports a substantial population of Western Grey Kangaroos, which are also common in the nearby Wyperfeld National Park, and was typical, before clearing, of much of the range of the Western Grey Kangaroo in Victoria. It is possible that the presence of Eastern Grey Kangaroos in this area reflects movement in response to the then prevailing drought conditions. However, emigration from populations

1. Department of Zoology, University of Melbourne, Parkville, Victoria, 3052
2. P.O. Yaapeet, Victoria, 3424

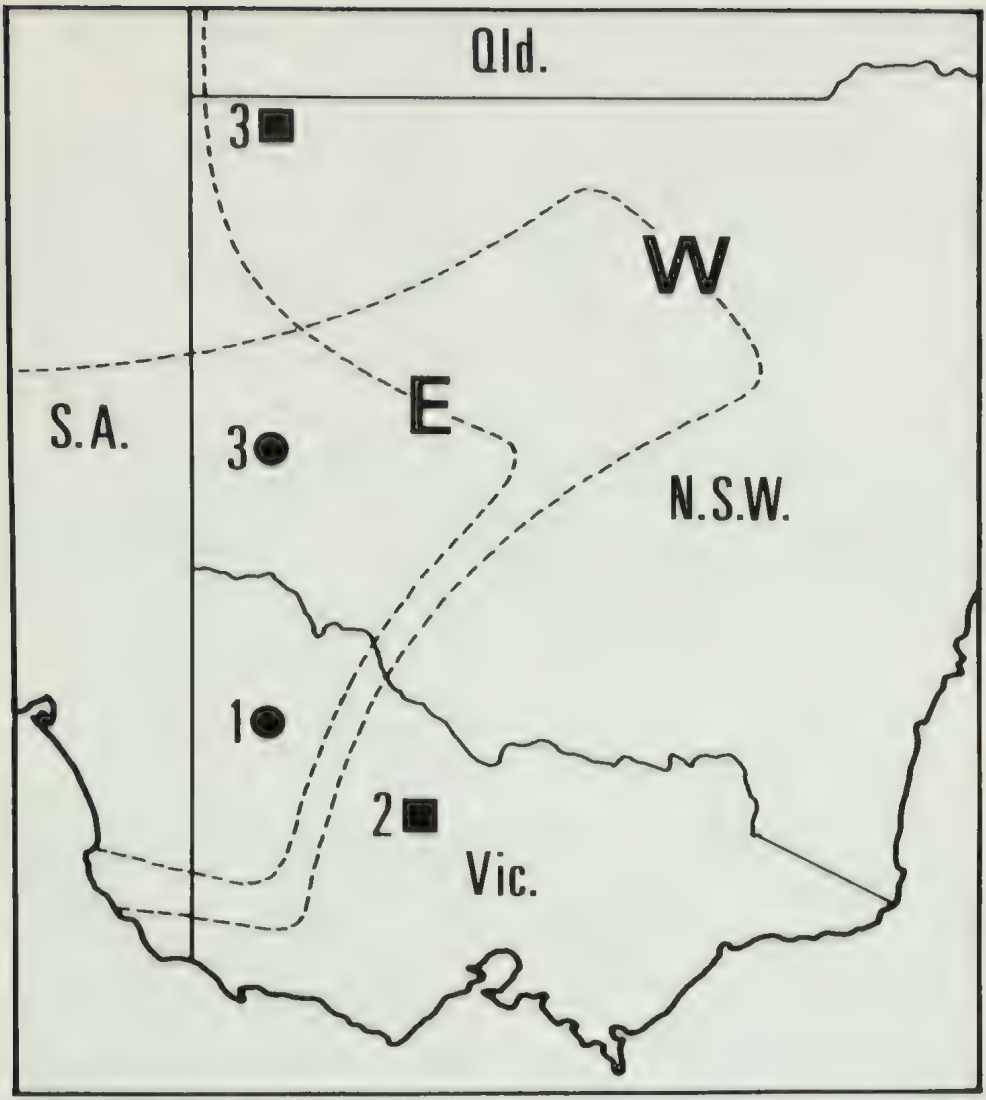



Fig. 1. Extensions of range of *M. giganteus* (circles) and *M. fuliginosus* (squares) reported by: 1 (this paper), 2 (Coulson, 1980), 3 (Shepherd, 1982). Broken lines show the presumed western limit of *M. giganteus* (E) and eastern limit of *M. fuliginosus* (W), after Poole (1977)

in more mesic environments to the south or east appears unlikely. It is more probable that Eastern Grey Kangaroos have long been present in the Wyperfeld area in much lower densities than Western Grey Kangaroos, as in Kinchega National Park (Shepherd 1982), and have not hitherto been recognised.

**Acknowledgements**

Bill Poole (CSIRO) confirmed the identification, and Linda Huxley (NMV) allowed access to the specimen. Angus Martin helpfully criticised the manuscript which was typed by Lyn Ramsay. The specimen was shot under a pest destruction permit from the Fisheries and Wildlife Division.

REFERENCES
Coulson, G. M., (1980). Extension of range of the western grey kangaroo, *Macropus fuliginosus*, in Victoria. *Victorian Nat. 97:* 4-5.
Hampton, J. W. F., Howard, A. E., Poynton, J. and Barnett, J. L., (1982). Records of the Mammal Survey Group of Victoria, 1966-80, on the distribution of terrestrial mammals in Victoria. *Aust. Wildl. Res. 9:* 177-201
Kirsch, J. A. W., and Poole, W. E., (1972). Taxonomy and distribution of the kangaroos, *Macropus giganteus* Shaw and *Macropus fuliginosus* (Desmarest), and their subspecies (Marsupialia: Macropodidae). *Aust. J. Zool. 20:* 315-339.
Poole, W. E., (1977). The eastern grey kangaroo, *Macropus giganteus*, in south-east South Australia: its limited distribution and need of conservation. *CSIRO Div. Wildl. Res. Tech. Pap.* No. 31.
Shepherd, N. C., (1982). Extension of the known range of western kangaroos, *Macropus fuliginosus*, and eastern grey kangaroos, *M. giganteus*, in New South Wales. *Aust. Wildl. Res. 9:* 389-391.



## Observation of Manna

By T. Sault*

Observations of the association of scale insects (Coccidae spp.) and ants in the manufacture and use of manna is always of interest and is well documented in books of insects. My most recent observation of this remarkable association was at Blackburn where a manna gum was covered with scale insects, manna and ants. It appears that in most cases the supply and demand are fairly equal, as only small amounts of manna can be seen because of the constant removal by ants. However, as a boy I can recall making several visits to a stand of manna gums above Snobs Creek Falls (near Eildon) where at times I could pick up pieces of manna the size of "pop-corn" scattered all over the ground beneath these gums. I did not know of this insect association then, but it has occurred to me since that perhaps as these gums were very tall, the ants may not have been able to reach the tips of the branches, or there may not have been enough ants in the area, hence supply exceeding demand and the manna was able to build up and be blown off by the wind.

I often wonder about the source of the manna referred to in the "scriptures". Dr Leach, in his book on "Nature Studies", tells us that the possible source of this manna is a species of lichen that grows in the Holy Lands, but he does not say whether this lichen has a tree or a rock for a host. The Middle East today is practically treeless, but history records that it was not always so. Alexander the Great was just one of the conquerors who desecrated the forests there, so it can be assumed that manna could have been produced in the Biblical lands in the same way as that produced above Snobs Creek Falls and not "sent from heaven" as written, although no doubt this is only a literary appreciation. The stands of manna gums at Snobs Creek were thinned out during milling operations over 40 years ago and although I have been back many times since, I have not witnessed the event again. I wonder if other readers have had similar observations of manna production exceeding demand.

* 13 The Avenue,
West Rosebud 3940
Victoria

# Bush-peas of Victoria — Genus *Pultenaea* — 17

By M. G. Corrick*

***Pultenaea d'altonii* H. B. Williamson in *Proc. Roy. Soc. Vict.* n.s. *35:* 102 (1922).**

This is one of Victoria's less common endemic species; it occurs in a few isolated localities west of Melbourne, including the Grampian's Black Range, the Little Desert, Brisbane Range and the south-west near Dartmoor.

*Pultenaea d'altonii* is a soft, erect shrub from 0.5-1 m high. The stems are terete and covered with a dense mixture of long and short pale hairs.

The alternate linear, or linear-obovate leaves are 5-12 mm long with a petiole of about 1 mm. They have tightly inrolled margins and obtuse tips. The lower surface is slightly scabrid and hirsute with long, pale hairs; the upper surface, when visible, is paler and less hairy.

The slender, dark brown, lanceolate stipules are 2-3 mm long, recurved, papery and easily torn.

The bright orange flowers are axillary and tightly clustered at the tips of the branchlets. The orange standard is about 10 mm long and 9 mm wide; the small, pale triangle at its base is surrounded by faint purple shading. The wings are orange, shaded with purple lines and the keel is orange with a purple tip.

The calyx is 6-7 mm long, with slender, acuminate lobes and is covered with pale, spreading hairs.

The bracteoles are trifid, 5-6 mm long and covered with pale hairs; the centre lobe is green and the outer lobes brown and papery. They are attached at the base of the calyx tube.

There are no bracts, but the leaves within the inflorescence are slightly reduced in size and have enlarged stipules.

The ovary is densely pubescent with soft pale hairs which continue halfway up the style. The pod is plump and does not extend beyond the calyx.

Flowering time ranges from mid September to late November; in a good season *P. d'altonii* is a handsome, soft and very floriferous shrub, often with slightly drooping branches.

SPECIMENS EXAMINED included: 17 km E. of Dartmoor, *A. C. Beaugle hole 55335*, 2.xii.1976 (MEL 568592); Little Desert, *M. G. Corrick 1928*, 26.x.1969 (MEL 1520558); Black Range, *M. G. Corrick 6130*, 23.x.1978 (MEL 1504361); Between Nhill and Goroke, *St. Eloy D'Alton*, x.1897 (MEL 35098) — Type; Brisbane Range, *H. B. Williamson*, 3.x.1926 (MEL 599488).

***Pultenaea vestita* R.Br. in Ait.f., *Hort. kew* ed.2, 3:19(1811).**

This is another of Victoria's rare species; it also occurs in S.A. and W.A., but is nowhere common. The only known Victorian colonies are in the Little Desert.

*Pultenaea vestita* is a low growing shrub, about 50 cm high. The stems are terete, but mainly hidden by the stipules; leaf scars are prominent on the older wood.

The alternate, linear, almost terete leaves are 5-12 mm long with a slender petiole, strongly incurved margins and obtuse tips terminating in a short fragile mucro. The lower leaf surface has long, spreading hairs on young growth; older leaves are glabrous. The upper leaf surface, if visible is glabrous. South Australian collections appear generally to have broader, flatter leaves.

The dark brown, papery stipules are 2-3 mm long, united at the base and enveloping the stem. They are fragile and soon torn.

* 7 Glenluss Street, Balwyn, Victoria.

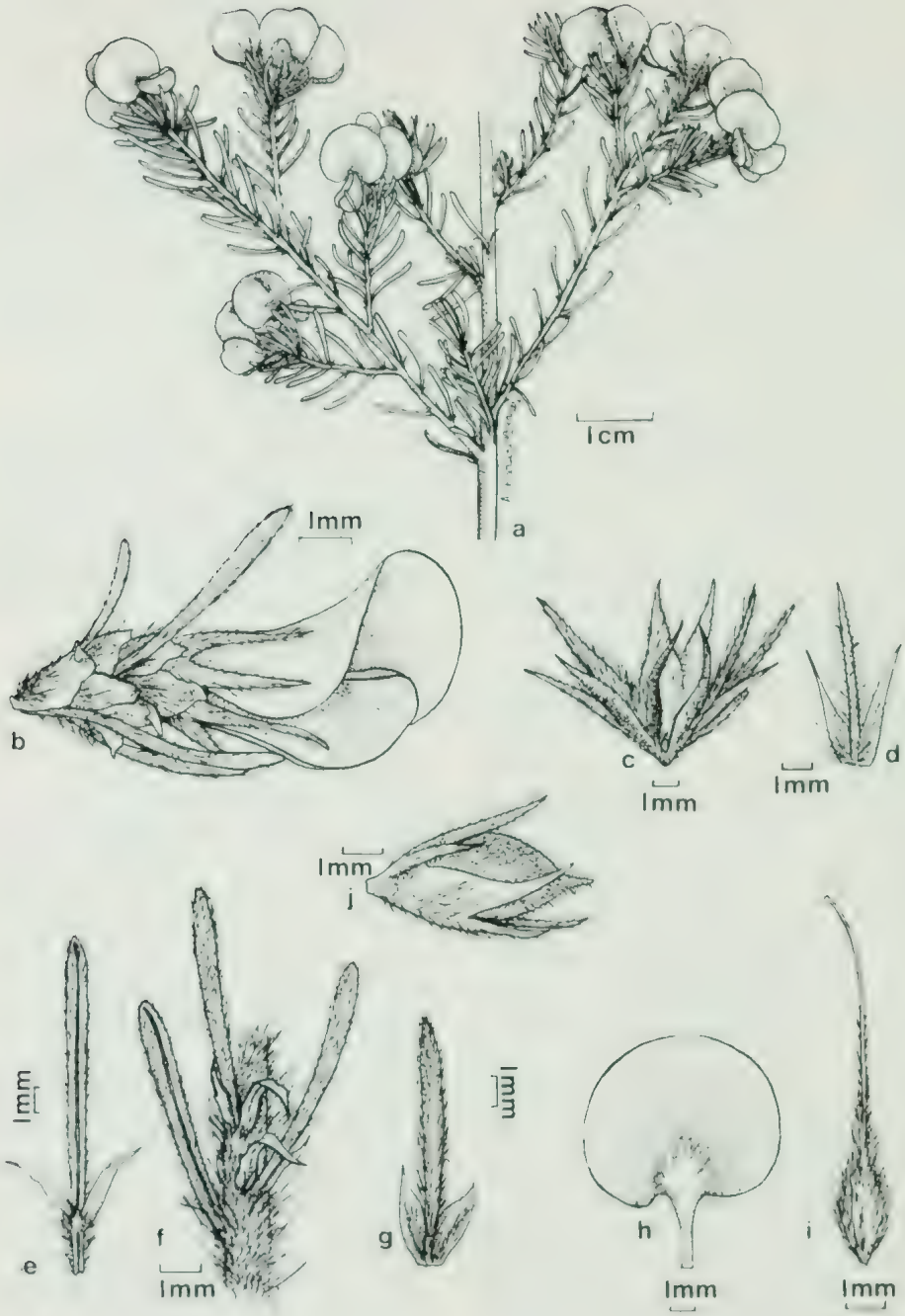



Fig. 24. *Pultenaea d'altonii*. a, habit; b, flower from side; c, calyx with bracteoles; d, bracteoles; e, leaf with stipules; f, section of stem with leaves and stipules; g, floral leaf with enlarged stipules; h, standard; i, ovary and style; (all from MEL 568588); j, pod; (from MEL 568588).

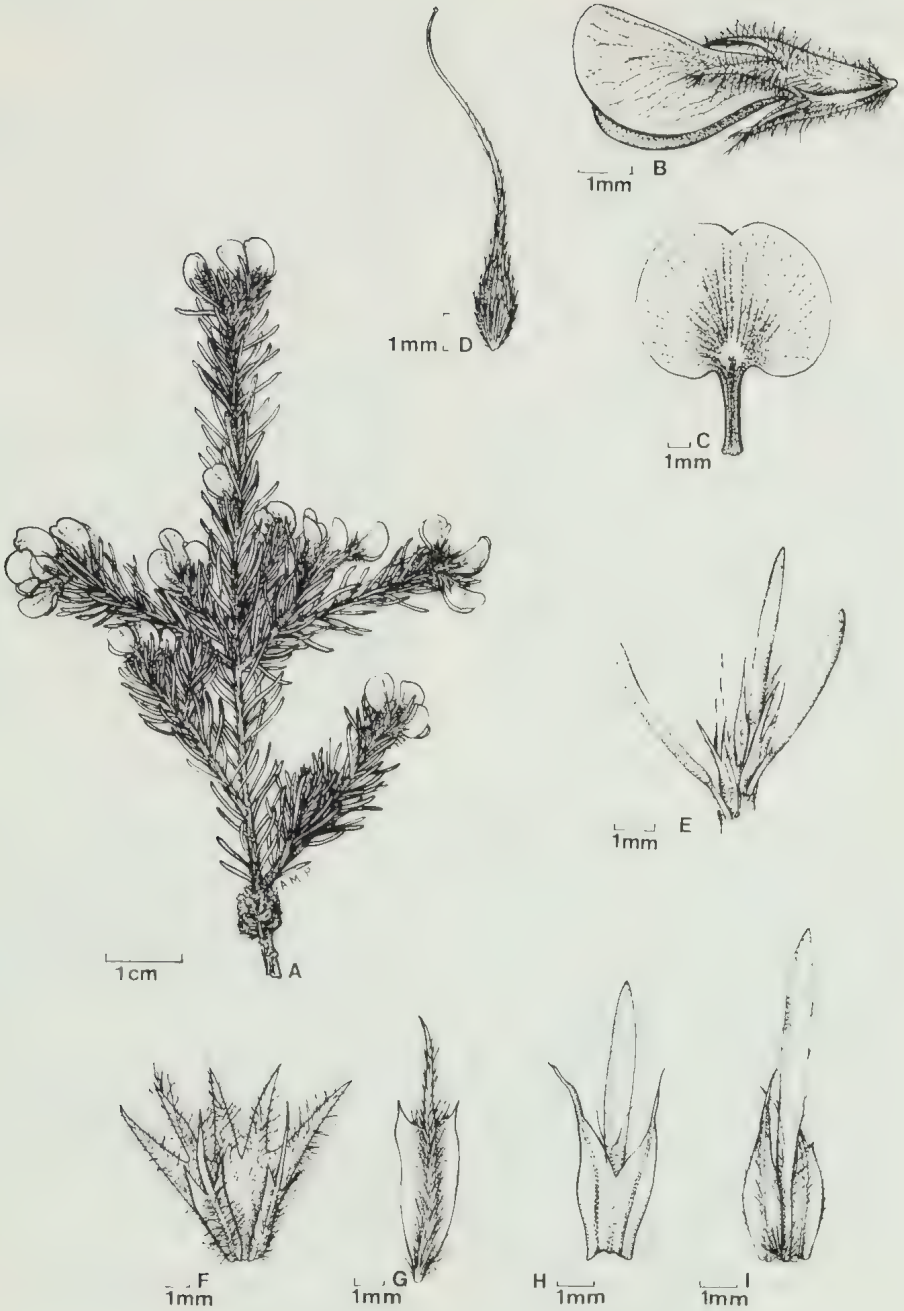



Fig. 25. *Pultenaea vestita*. A, habit; B, flower from side; C, standard; D, ovary and style; E, section of stem showing leaves and stipules; F, calyx with bracteoles; G, bracteole; H and I, floral leaves with enlarged stipules, (all from MEL 641987).


◆ *Pultenaea d'altonii*
□ *P. vestita*

Fig. 26. Known distribution of *P. d'altonii* and *P. vestita*.

The flowers are axillary and tightly clustered in small groups at the tips of the branches. They are not showy, being partly hidden by the crowded leaves and long calyx lobes. The orange standard is 11 mm long and 7 mm wide; it is strongly marked with purple lines and shading almost to the edge. The keel is purple and the wings orange.

The calyx is 9-10 mm long with slender, acuminate lobes and is covered with dense, soft, pale hairs.

The bracteoles are about 5.5 mm long, trifid and leaf-like; the centre lobe is green and hairy; the large outer lobes are brown and papery; they are attached at the base of the calyx tube.

The flower clusters are tightly enclosed by leaves with much enlarged stipules; occasionally the leaves closest to the flowers will break off leaving the stipules, which may then be mistaken for true bracts.

The ovary is densely covered with pale hairs; scattered hairs extend half-way up the style.

The pod is enclosed and almost hidden by the calyx. Flowering time is late October to early December.

SPECIMENS EXAMINED included: Little Desert, *A. J. Hicks,* late October 1948 (MEL 35405); Little Desert, *A. C. Beauglehole 66826,* 28.x.1979 (MEL 641987).

## STATE CONSERVATION STRATEGY

The Government of Victoria is developing a State Conservation Strategy, with the aim of integrating sustainable development and the conservation of nature and natural resources. As an initial step in this process, a Discussion Paper (of 187 pages) has been prepared on *Conservation in Victoria.* The purpose of this paper is to provide a basis for public consideration of conservation issues and to encourage people to put forward their views. The involvement of the community is essential if a workable and responsible Conservation Strategy is to be achieved.

All submissions will be considered in the preparation of both a draft Strategy statement and the initial Strategy implementation plan. Further opportunities for public involvement will be provided throughout the Strategy process.

Copies of the Discussion Paper are available for $2.00 per copy ($3.00 posted) from the Ministry for Conservation, 240 Victoria Parade, East Melbourne, Victoria (tel. 651 4795). Posters and leaflets are also available.

Submissions should be received by 18 November, 1983.

## What Fossil Plant is That?

BY JOHN G. DOUGLAS

We apologise to those people who placed pre-publication orders for this book.

Publication has been held up by printing delays.

Orders will be fulfilled as soon as is practicable.

# A Sighting of Southern Right Whales *(Balaena glacialis australis)* at Venus Bay, Victoria.

By L. F. Lumsden[1] and M. Schulz[2]

There have been few published records this century of Southern Right Whales *(Balaena glacialis australis)* off the Victorian coast. These whales were hunted close to extinction and, although showing signs of a recovery, they are still considered to be one of the rarest of the large whale species.

On 3 July 1982 we observed an adult and calf Southern Right Whale off Venus Bay, south-eastern Victoria (38°40'S, 145°46'E). The animals were first sighted approximately one kilometre offshore at 1200 hours, four kilometres south-east of Anderson's Inlet entrance. Observations were made continuously between 1415 and 1630 hours (until just before dusk), from a vantage point directly opposite the whales. The animals remained in the same general position throughout the entire observation period. Viewing conditions were ideal with calm seas, good visibility and extended sunny periods.

The animals were identified as right whales by the absence of a dorsal fin, the long flat back protruding above the surface of the water, the presence of large dark paddle-shaped flippers, the broad deeply notched tail flukes with pointed tips, the "bonnet" — a pale cornified structure on the crown of the head (an excellent photograph of this feature is shown on the cover of *The Victorian Naturalist* Vol. 96, No. 5), and the large arched mouth, all of which are features diagnostic of this species (Gaskin, 1972). The adult was estimated to be about fifteen metres in length and the calf approximately one third its size. Calves are five to six metres at birth (Watson, 1981), which suggests that the calf had been born recently.

1. 57 Koala Cres., West Meadows. Vic. 3049.
2. 37 Halifax St., Middle Brighton. Vic. 3186.

For a large proportion of the observation period the adult remained motionless with the upper parts of the back and head exposed. It submerged sporadically, using no push or movement of the tail flukes, and re-emerged in the same position and orientation, exhaling water in either a vertical or slightly forward spout. On several occasions the adult appeared to dive more deeply, first raising its flukes high and sounding in a more vertical position, and remained below the surface for considerably longer periods. The animal often rolled on to its side and extended one flipper above the water. Sometimes it rolled briefly on to its back with both flippers extended. When lying quietly at the surface, normally only the upper parts of the head were in view, but on several occasions it raised its head clear of the water revealing its strongly arched mouth.

During the period of observation the calf stayed close to the adult, never straying more than about fifteen metres, as judged from the length of the adult. The calf displayed all the movements exhibited by the adult but was more active. It was continually in motion, swimming up and down the length of the adult, and often diving or rolling on its side or back extending one or both flippers.

Activity of both the adult and the calf decreased towards dusk, with less rolling apparent and less of the body exposed. Instead of the common posture with the back and head showing above the water, often only the top of the head was exposed.

The same location was revisited at 1200 hours on 4 July 1982 but the whales were not resighted. Weather conditions were similar to that of the previous day, although there was a light southwesterly

Southern Right Whale

breeze and occasional heavy rain showers.

**Other Sightings over the Same Period**

Several other sightings of the Southern Right Whale were made on the Victorian coast during July 1982. An adult and its calf were sighted off Kilcunda on 11 July and these were probably the same animals as seen off Venus Bay (R. Warneke, pers. comm.). A single adult was seen off Darby Beach, Wilson's Promontory (Schulz, pers. obs.) and several sightings were made of right whales from Phillip Island — off Point Grant and Seal Rocks (R. Warneke, pers. comm.). During this period the largest aggregation was observed at Lady Bay, Warrnambool in western Victoria, where up to eight adults and seven calves were observed, the first animal being reported in late May and the last in October 1982 (R. Warneke, pers. comm.). Not since last century have aggregations like this been observed off the Victorian coast.

The number of recent sightings in Victorian coastal waters suggests that this species is slowly recovering from the extensive shore-based and pelagic whaling operations around south-eastern Australia in the last century, which as part of the world-wide over-exploitation, brought the species close to extinction. Gaskin (1972) commented on a similar increase in the number of sightings in New Zealand waters, which he pointed out "cannot be attributed to increased interest in cetaceans alone". Signs of a recovery in right whale populations have also been noted off Tristan da Cunha and Chile (Gaskin, 1972), off South Africa (Best, 1970) and off Patagonia (Payne, 1976).

**Acknowledgements**

We would like to thank J. M. Dixon for helpful comments, and R. M. Warneke for access to unpublished information and his many constructive comments on the draft.

REFERENCES

Best, P. B. (1970). Exploitation and recovery of right whales off the Cape Province. *Rep. Div. Sea. Fish. S. Afr. 80:* 1-20.

Gaskin, D. E. (1972). *Whales, dolphins and seals.* Heinemann, Auckland.

Payne, R. (1976). At home with right whales. *Nat. Geog. 149:* 322-339.

Watson, L. (1981). *Sea guide to whales of the world.* Hutchinson, London.

# Traces of Boring Mussels at Waratah Bay, Victoria

BY PETER CORCORAN*

Many types of rock contain impressions and burrows but these traces and borings are often an enigma. A burrow may have been formed last year or it could have been made by an animal millions of years ago. Occasionally there is a clue to an animal's identity. For example fossilized sections of the tabulate coral *Syringopora* are often discernible when this coral's tubular meanderings are found encased in limestone. In many cases however, by its very nature a completely empty hole leaves many questions unanswered. The age of the cavity and the species of animal which made it may only be guessed.

A recent find at Bell Point, Waratah Bay, South Gippsland, has maintained the reputation of empty holes for creating problems.

A small water-worn limestone pebble measuring 755mm x 50mm x 20mm was found among similar rocks just above high water level in the small cove north of Bell Point. From the colour and location of the pebble it is presumed to be derived from either the Bell Point or the Waratah Limestone units, both of which are Devonian in age. The pebble contains twenty empty burrows. Some penetrate the rock completely, others end blindly. There is no trace of the infilling which would be expected if the animals were of Devonian age. There is no fossil evidence of a fauna younger than species of the Devonian Period in this part of South Gippsland. It may be inferred therefore, that the holes were excavated by a modern type animal, that is, a species living from the Pleistocene to the present.

The burrows have a dumb-bell shaped aperture measuring 3mm × 1mm (Fig. 1.). The longitudinal section is flask shaped with a diameter near the base of 3mm to 4mm. A typical length from base to aperture is about 20mm and the impression of concentric growth lines is visible on the rock wall. (Fig. 2). As the burrow interior is larger than the aperture, the animal must have been a permanent occupant of its burrow. The morphology compares with the description of the burrows of Date Mussels, *Lithophaga* spp. (Allan, 1959) and with burrows of living animals of this genus from the Great Barrier Reef. Victorian waters have boring bivalves such as *Panopea australis* (Southern Gaper), *Pholas* spp. (Angel's Wings), and the infamous *Teredo* (Shipworms), but these species do not make the type of burrow found in this limestone pebble. However, Date Mussels or similar borers are not known from south-eastern Australia.

Date Mussels burrow into limestone using a chemical process to loosen and

Fig. 1. Dumb-bell shaped aperture of the burrows. Magnification ×5.

* C/o Department of Invertebrate Palaeontology, Museum of Victoria, Russell Street, Melbourne, Victoria, 3000.

Fig. 2. Longitudinal section of the burrows showing impressions of concentric growth lines. Magnification × 5.

then expel rock particles. They are known to inhabit, some say infest, large areas of the Great Barrier Reef. Their range extends southwards to about Taree on the central New South Wales Coast. Boring bivalves are also known in other Australian waters. The Indian Ocean and Great Australian Bight areas of Western Australia and, possibly, Spencer Gulf, contain genera of which *Botula* is one. These have a different burrow morphology to that of the Waratah Bay burrows. All these recorded habitats are a long way from South Gippsland.

The question is — how did these animals, if they are Date Mussels, arrive in Waratah Bay? It is known that the generally south flowing warm water current off the eastern coast of Australia contains large eddies. These eddies carry warm water fauna. The warm water species are observed in pockets even when surrounded by cold water, as the eddies penetrate south.

These eddies have not been observed to enter Bass Strait against the eastward drive of cold Antarctic derived water, although there are remnant areas of subtropical vegetation in Gippsland as far west as the valley of the Mitchell River, north of Bairnsdale. This growth has been induced by the southward flow of warm water into this Temperate region.

It is possible that a body of warm water rounded Cape Howe, perhaps in the period immediately before the complete flooding of Bass Strait, or at another time. It might have carried larvae of a species of Date Mussel which established a colony in the relatively sheltered waters of Waratah Bay.

If this supposition and its conclusion are correct, a second question arises. Was this colony eradicated by the influx of the normal cold water? Or is it possible that there is a colony still living in the limestone rocks of Waratah Bay?

**Acknowledgement**

I wish to thank Joan Phillips of the Department of Invertebrate Zoology, Museum of Victoria, for generously showing me her research work on the *Lithophaga* from Heron Island and for her corrections of outdated synonyms, and one possibly incorrect provenance.

REFERENCE

Allan, Joyce (1959) *Australian Shells*. Georgian House, Melbourne

## Compendium of Seashells

R. Tucker Abbott and S. Peter Dance
E. P. Dutton, New York, 1982.
$49.95.

Considering the extensive number of books on shells and shell collecting it is surprising that this volume offers the first comprehensive coverage of the great diversity of shell form. Collectors can now have a single volume which will allow them to identify to family (and often to genus) virtually any shell available to them. The authors, R. Tucker Abbott and S. Peter Dance, are both experienced in the production of popular books of high standard.

In all, over 4000 species are documented, each illustrated by a colour photograph (some of type specimens) with details of distribution, habitat, abundance and synonyms. The scientific name of each species is supplemented by a common name, many of which are clumsy and most quite unnecessary. Inevitably with a work of this size, the quality of the photographs is variable; all are adequate, and some are excellent.

Each family is briefly introduced with details of any characters common to the group. The number of species illustrated for any given family reflects their interest to collectors rather than the true abundance of the group, e.g. only three species of the entire superfamily Rissoacea are included. The inclusion of a large number of bivalve species is most welcome, as this group is so often ignored by writers of popular shell books.

The introduction details many biological concepts relevant to shell collectors. It includes a lucid account of molluscan classification, taxonomy and nomenclature, introduces readers to the biological species concept and provides definitions of the various type specimens. Such basic information is essential if shell collectors are to enjoy their collections as anything more than a number of isolated, though beautiful, objects. A most welcome section is that on conservation, although one wonders which studies have shown that collecting is 'no real menace to molluscan populations'.

But all this aside, it is the final ten pages of the book which will probably be most used by amateur and professional alike. These constitute a bibliography, arranged by family and by region, of all relevant review articles available on the group/area.

In a comprehensive review of this size errors and/or omissions are inevitable, but they are few and minor in this volume. I recommend this book to all who are interested in shells and shell collection, but realise its high price (however justifiable) will prevent many people acquiring it for their personal libraries.

— S. E. BOYD

# Observations of the Drought in the Warby Ranges, N.E. Victoria

By I. C. Morris*

During the recent drought (1982–83) the Wangaratta district, including the Warby Ranges, recorded the lowest rainfall for 100 years. Between March 1982 and March 1983, 7½ inches or 176mm fell, which is slightly more than a quarter of the average rainfall of 25" per annum. High temperatures were also recorded during the summer of 1982-83 with 41 days above 35°C.

By November 1982 most springs, small streams, waterholes and farm dams had dried up. Drought conditions were, by then, extreme.

These comments are related to my observations of the effects of this drought in the dry schlerophyll forest of the Warby Ranges where I live.

**Vegetation**

By December 1982 the canopy of the forest, predominantly Blakely's gum *(Eucalyptus blakelyi)* and Red Stringybark *(Eucalyptus macrohyncha),* was defoliated, partly from attacks by lerps, but mainly from lack of subsoil moisture. Other eucalypts e.g. Red, Yellow, Grey, White and Long-leaf Box, which are found sporadically in the Warby Ranges, survived much better and were only partially defoliated. Larger Acacias suffered much stress and leaf loss e.g. *Acacia implexa,* while smaller bush Acacias, e.g. *Acacia buxifolia* died. The understorey shrubs, wildflowers and orchids were showing the effects of drought by July 1982. Orchids such as *Pterostylis, Acianthus, Caladenia* and *Diuris* species produced leaves, but flowers did not develop. Any flowering which occurred in wildflowers, e.g. *Pimelea, Hibbertia, Brachyloma* species, was scanty and of short duration.

Grass trees *(Xanthorrhoea australis)* showed stress by browning of all but central long spikey leaves.

By January 1983 almost everything in the bush looked stark, brown and lifeless.

**Birdlife**

By early spring 1982 it was apparent that birds were aware of unusual or difficult conditions, as there was a reduction in numbers of birds breeding of all species. I noticed also that some species e.g. Red Cap Robins and Blue Wrens, instead of laying the usual 4-5 eggs, laid only 1 or 2 eggs. Robins, Blue Wrens, Thornbills etc. which commonly raise 3 to 4 clutches during spring and summer, raised only 1, or at the most, 2 clutches. The exception to this was the Finches (Red browed, Zebra and Diamond Firetail) which continued breeding after any shower of rain, and bred 3 or 4 times during spring and summer.

Rainbow bee eaters arrived from the north in September in their usual numbers. Early November they commenced digging their nesting burrows in the rockhard gravel soil. 10 days after completion of burrows (70–100cms long) all nests under my observation were deserted. The most probable explanation for this was the lack of, or extreme reduction in, insect life on which they feed — in particular all species of indigenous dragonfly, also the smaller moths, insects and grasshoppers on which they feed their young.

As the summer progressed, with its extreme heat, the population of many species declined substantially. Some species e.g. Flycatchers, Whistlers, Cuckoos, Tree creepers etc. are known to sometimes make short summer migrations to the less harsh conditions of the foothills of the Australian Alps.

* R.M.B. 8610, South Wangaratta, Victoria, 3678.

Fatalities in birds due to the drought occurred mainly with fledglings and usually on days of extreme heat. Inexperience at finding water, which was very scarce, may have contributed to lack of survival.

On a day when the temperature was 44°C one fledgling Yellow-tufted Honey eater died while perched in a *Grevillia* bush only 20 metres from a small pond. This small pond (150cm × 75cm × 25cm deep) being the only surface water for a radius of 2 or 3kms or more, was a mecca for birds and wildlife.

Birds drank and bathed in it, with peak activity near dawn and dusk, when in only an hour up to 40 species could be counted. Some would come in flocks of 10–40 e.g. Silvereyes, Thornbills, Finches, Honeyeaters etc. Others would come in pairs or family groups of 3–5, e.g. Parrots (Turquoise, Red Rump, Eastern Rosella etc.) Robins, Shriketits, Peaceful Doves, Black-eared cuckoos etc. Kookaburras and Ravens would bathe in turn. On one memorable occasion a Wedgetail Eagle was seen standing in the water drinking. It is possible that without this source of water (which I had to transport 18 kms) many birds would not have survived.

**Wildlife**

Once the dams, springs and streams on my property and neighbourhood, had dried up (by mid November) the wildlife became more visible, because they needed to use the small pond in my unfenced garden, 10m from my house. It was in constant use for both drinking and bathing, by Grey Kangaroos, Swamp Wallabies, Echidnas (quite a fascinating sight to watch an Echidna bathe and preen itself) Goannas, Snakes, etc. No doubt small marsupials used it during the night, such as Possums, Gliders, Marsupial mice, etc. Though birds would give warning calls if the pool was occupied by one of their natural predators, on the whole the wildlife population seemed to call a truce of "live and let live" and mingled quite closely at the water.

Kangaroos and wallabies, when hard pressed for food, ate from the shrub understorey (1–2m high) e.g. *Grevillia alpina,* young *Casuarina, Callitris,* green tops of grass trees and various native shrubs, e.g. *Calothamnus* in my garden. Young Kangaroos and Wallabies of the age of leaving the pouch eventually disappeared. No doubt they perished due to lack of grass and small herbage at ground level for food. The fate of small marsupials is unknown to me, but house mice and rats which usually find their way into the house at the onset of cold weather, appear to have been completely wiped out.

**Insect Life**

Insect life was dramatically reduced by the drought, as could be demonstrated by leaving an outside light on at night. This would only attract a few insects (10–20) compared to normal summers, when a light would be surrounded by a cloud of thousands of insects, ranging from tiny midges to large moths and beetles. Very few dragonflies or grasshoppers hatched or were to be seen.

Bees, both small bush bees and domestic bees, were very much in evidence, where any water was available, including a glass of water or soft drink left outside. Ants were only seen if there was a spillage of water, no matter how small, on the ground, or at times when a change of weather was imminent.

Flies and mosquitoes were mercifully absent through the heat of the summer, and no cicadas were to be heard.

However, as such a large proportion of the bird population survived, I presume there were sufficient insects for their food, even if not highly visible.

The first significant rain suggesting the drought was broken commenced on 21 March and 60mm fell over the next 3 days. A condition for much rejoicing!

Good rains have since fallen at regular intervals transforming the bush and the countryside. Now, 6 months later, significant regeneration of the native flora is taking place in a manner which borders on the miraculous.

## Field Naturalists Club of Victoria

Reports of recent activities

**General Meeting**
**Monday, 8th August**

**Members** observed one minute's silence on the recent passing of Jean Blackburn. Mrs Gwynnyth Taylor then paid tribute to Jean, a member of the Club since 1947. A former excursion secretary Jean was a keen botanist, a love which undoubtedly carried over into her involvement with the V.N.P.A. in conservation, and the Melbourne Women's Walking Club.

**Honorary Membership** was conferred on Ellen Lyndon, a member for 40 years, who has been an active conservationist especially in issues concerning Gippsland.

**On the launching** of Cliff Beauglehole's 'The Distribution and Conservation of Vascular Plants in the Melbourne Study Area', Lionel Elmore stressed the importance of plant conservation and the significance of this report, which covers the 28,000 km² of the Melbourne Study Area, in that direction. Published by the Western Victorian Field Naturalists Clubs Association and at considerable expense to Cliff, Lionel urged members to buy this report so that Cliff many continue his work and so that people may become more aware of the particular needs with regard to plant conservation in this State.

**Speaker** for the evening was Mr Beauglehole who outlined the structure and layout of his report and the system he uses for recording the plants.

Cliff then showed slides of collected specimens of some of the particularly rare or restricted species and related his experience with each of those plants shown. Amongst the more unusual of his experiences was the time his wanderings brought him upon a crop of marijuana plants growing in the bush amongst swamp bush peas!

The relatively small number of species shown gave only some idea of the very many hours that Cliff has spent in the field searching, identifying and also the collating of the data gathered. Naturalists/conservationists are indebted to Cliff for his work.

**Conservation:** Malcolm Turner informed those present that the Club's submission on the L.C.C.'s Proposed Recommendations for the Alpine Study Area had been completed and sent off.

The Alpine Resorts Bill, to be debated shortly in State Parliament, sets up an Alpine Resorts Commission which has a pro-development bias and a number of powers that are potentially dangerous as far as the conservation of the Alps is concerned. Malcolm urged people to write to the relevant Ministers to express their opinions and ideas.

Malcolm also reported that various members of the Conservation Committee were working on comments in response to a number of recently published reports, namely the Mount Sterling Alpine Resort draft proposal, the National Parks Service proposed interim report on the Bogong National Park, and the Forests Commission report on the Rodger Management Block.

**Exhibits & Nature Notes:** One member had on display photographs and documentation outlining the effects of a fuel reduction burn which was carried out near Hamilton.

Several exhibits which required

specific identification were some terrestrial planaria which were found to be plentiful under rocks, an aquatic plant which was subsequently identified as the introduced *Juncus articulatus*, and a number of 'sea monkeys' (brine shrimps) from a saltwater pond at the Cheetham salt works. Another exhibit of a skink with a very long tail (1½ times the length of the body) was confirmed as being the weasel skink, *Leiolopisma mustellina*.

A report came from a member of starlings pecking into a lawn with their beaks open — the reason for such behaviour being unknown.

---

(continued from inside front cover)

## GROUP MEETINGS

FNCV members are invited to attend any Group Meeting

**Day Group — Third Thursday.**

Thursday, 20th October. Monash University grounds. Meet at Monash bus terminal, 11.30 a.m. Leader J. Zirkler (ph. 568 8337).

Thursday, 17th November. Botanic Gardens, with Madge Lester and other official guides. Meet at kiosk 11.30 a.m. Organiser H. Stanford (ph. 830 1505).

No meeting in December.

At the National Herbarium, Birdwood Avenue, South Yarra at 8.00 p.m.

**Botany Group — Second Thursday.**

Thursday, 13th October. Ilma Dunn, Kangaroo Island.

Thursday, 10th November. Hilary Weatherhead, Goodeniaceae.

Thursday, 8th December. Members night.

**Geology Group — First Wednesday**

Wednesday, 5th October. A profile of the Earth under the oceans

Wednesday, 2nd November. The Earth's Heat, causes and effect

Wednesday, 7th December. Members night.

**Mammal Survey Group — First Tuesday**

Tuesday, 4th October. Bob Warneke, Seals.

Tuesday, 25th October. Jerry Alexander, 'Taxonomic relationship between the Squirrel Glider and Sugar Glider,' AND Peter Menkhorst, 'The use of artificial nest boxes by possums and gliders'. N.B. THIS IS THE NOVEMBER MEETING.

Tuesday, 6th December. Harry Parnaby, Bats.

**Microscopy Group — Third Wednesday**

Wednesday, 19th October. Mr J. Dawes, Development of microphotography.

Wednesday, 16th November. Mr P. Genery, Movies through the microscope.

---

## Intertidal Zone Legislation

Legislation has been enacted to prohibit the collecting of molluscs and crustaceans from the intertidal zone. The amendments to the Fisheries Act 1968 — Shell Fish Protection Regulations 1983 — came into operation on 3 August, 1983. Prior to these regulations, marine biota of intertidal areas was not protected except for that occurring within a marine reserve.

Under the amendments

* every person without the written permission of the Director who takes from a recognized shell fish habitat —

(a) any mollusc other than squid, octopus, cuttlefish, abalone and squirter; or

(b) any crustacea other than bass yabbies (ghost shrimp), southern crayfish, crabs and sand fleas;

shall be guilty of an offence against the Regulations.

* under the regulations 'Shell Fish Habitat' means tidal flats, sandbanks and other terrain below high water level along the coastline of Victoria or in the inlets, estuaries, bays, rivers and creeks in Victoria affected (either regularly or intermittently) by tidal influence that are not permanently covered by water or are for the time being covered by water less than 2 metres deep.

Other regulations relate to the implements (spades, pumps, sieves etc.) that may be used in a recognized shell fish habitat.

# *Field Naturalists Club of Victoria*

Established 1880

Registered Office: F.N.C.V., c/- National Herbarium, Birdwood Avenue, South Yarra, 3141.

**OBJECTS:** To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

*Patron:*
His Excellency Rear Admiral SIR BRIAN S. MURRAY, KCMG, AO.

**Key Office-Bearers 1983-1984**

*President*
Miss WENDY CLARK, 27 Rangeview Grove, North Balwyn, 3104 (859 8091 A.H.)
*Vice-President:*
*Hon. Secretary:* Mrs SHEILA HOUGHTON, 30 Golf Links Crescent, Dingley, 3172 (551 2708 A.H.)
*Hon. Treasurer:* Mr DAVID DUNN, 3 Allfrey Street, East Brighton, 3187 (578 5753)
*Subscription-Secretary:* Miss H. MALCOLM, c/- F.N.C.V. National Herbarium, Birdwood Avenue, South Yarra, 3141
*Editorial Material:* Forward to Ms J. U. PHILLIPS, Museum of Victoria, Russell St., Melbourne, 3000.
*Librarian:* Mrs JANE CALDER, c/- F.N.C.V. National Herbarium, Birdwood Avenue, South Yarra, 3141
*Excursion Secretary:* Miss MARIE ALLENDER, 19 Hawthorn Avenue, Caulfield, 3161 (527 2749)
*Book Sales Officer:* Mr D. E. McINNES, 129 Waverley Road, East Malvern, 3145 (211 2427)

**Group Secretaries**

*Botany:* Mr PETER CARWARDINE, 2a Victoria Road, Malvern, 3144 (509 0622 B.H. 211 8958 A.H.)
*Day Group:* Mrs E. I. GILLESPIE, 23 Wild Cherry Road, Carnegie 3163 (578 1879)
*Geology:* Mr TOM SAULT, c/- F.N.C.V., National Herbarium, Birdwood Avenue, South Yarra, 3141
*Mammal Survey:* Mr LANCE WILLIAMS, 29 Erica Crescent, Heathmont, 3135 (879 1962 A.H.)
*Microscopical:* Mrs ELSIE GRAHAM, 147 Broadway, Reservoir, 3073 (469 2509)

**MEMBERSHIP**

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

**Subscription rates for 1983**

| | |
|---|---|
| Metropolitan | $15.00 |
| Joint Metropolitan | $18.00 |
| Country Members and Retired Persons | $12.00 |
| Joint Country and Joint Retired | $15.00 |
| Junior | $3.00 |
| Subscription to Victorian Naturalist | $13.00 |
| Overseas Subscription to Victorian Naturalist | $15.00 |
| Individual Journals | $2.20 |

All subscriptions should be made payable to the Field Naturalist Club of Victoria and posted to the Subscription Secretary

Jenkin Buxton Printers Pty. Ltd. 113 ABBOTSFORD ST. WEST MELBOURNE 328 4774 329 7959

# The Victorian Naturalist

Vol. 100, No.
Nov/Dec
1983

Published by the FIELD NATURALISTS CLUB OF VICTORIA
in which is incorporated the Microscopical Society of Victoria

Registered by Australia Post. Publication No. V.B.P. 1268

$2.20

## FNCV DIARY OF COMING EVENTS

# GENERAL MEETINGS

**Monday, 12th December, 8.00 p.m.**
Dr Ian Bayly, Plankton of an Antarctic Fiord.
Honorary membership will be awarded to Mr W. H. Fulton.

**Monday, 9th January, 8.00 p.m.**
Members night.

**Monday, 13th February, 8.00 p.m.**
Dr Beth Gott. The use of plants by Victorian Aborigines.

### New Members — November/December General Meetings

*Metropolitan*

L. A. Black, 58 Sutton St., Nth Balwyn
Daniel Slater, 96 Canterbury Rd., Middle Park (Mammal Survey & Marine Biology)

*Country*

Con Boekel, RMB. 4135 Alexandra
C. Chadwick, 1/155 Herring Rd., Nth Ryde (Entomology)
Geoffrey Ross, Zoology Dept., University of Sydney.

# FNCV EXCURSIONS

**12th-19th January**, King Island, see last Naturalist.

**Australia Day Weekend January**, Snowy Range camp-out led by Dr Jim Willis and John Milligan. See last Naturalist and direct enquiries to John Milligan 557 3509.

**Sunday, 5th February**, French Island. Meet at Stoney Point in time to catch the 10 a.m. ferry to Tankerton. There will be a coach tour of the island led by a local guide interested in natural history. Afternoon tea will be provided in one of the old homesteads but bring a picnic lunch and tea. Fares for ferry and island tour $15.00. There is a train/bus service to Stoney Point to connect with the ferry leaving Melbourne at 8.45 a.m. The bus meets the train at Frankston. These times were given early November so it would be wise to confirm them.

**February 11th-12th,** Murrindindi — looking at life in stream and billabong — led by Ros St Clair. This is a joint excursion with the Mammal Survey Group and there will be mammal trapping and spotlighting in the evening and those attending may camp overnight if they wish.
Contact Wendy Clark ph. 859 8091.

**March 10, 11, 12th,** Cape Liptrap — combined group excursion/survey. See next Naturalist.
Contact Julian Grusovin ph. 387 7151.

**Labour Day Weekend, 10, 11, 12th March,** save this date for the combined VFNCA weekend get-together. Details in next Naturalist.

# GROUP EXCURSIONS

All FNCV members are invited to attend Group Excursions.

**Mammal Survey Group.**
December 26th — January 1st. Howitt plains.
Australia Day weekend — combined group excursion to Snowy Range.
February, 11th-12th Murrindindi.
March 10, 11, 12th Cape Liptrap.

**Botany Group.**
Saturday, 25th February. To be announced.
Saturday, 31st March. Berries — Upper Thomson Valley.

# GROUP MEETINGS

FNCV members are invited to attend any Group Meeting.

**Day Group — Third Thursday.**
Thursday, February 16th. Yarra River Walk. Leader: J. Wilson, 836 3521.
Thursday, March 15th. Hampton. Leader: D. McInnes, 211 2427.
At the National Herbarium, Birdwood Avenue, South Yarra at 8.00 p.m.

**Botany Group — Second Thursday.**
No meeting in January
Thursday, 9th February. East Gippsland — John Blyth.
Thursday, 8th March. Tundra — Mary Boery.

**Geology Group — First Wednesday.**
No meeting in January
Wednesday, 1st February. Members night.
Wednesday, 7th March. The ruins of Pompei — Mr and Mrs Love.

**Mammal Survey Group — First Tuesday.**
No meeting in January.
Tuesday, 7th February. Members night.
Tuesday, 6th March. To be announced.

**Microscopy Group.**
Wednesday, 18th January. Members night.
Wednesday, 15th February. Collecting pond life and observation by Mr D. Wentworth.
Wednesday, 21st March. Diatoms. Mr K. Blaze, TO BE HELD AT MELBOURNE UNIVERSITY.


# The Victorian Naturalist

Volume 100, Number 6

November/December, 1983
ISSN 0042-5184





*Cover Illustration:* The Tiger Quoll *(Dasyurus maculatus)* is an uncommon to rare carnivore of tall forests in the Angahook-Lorne Forest Park. See article on page 224.

# Mammals of the Angahook-Lorne Forest Park, Victoria.

By L. E. Conole,* and G. A. Baverstock†

## Introduction

From September 1981 to July 1982, the authors surveyed mammals in the western section of the Angahook-Lorne Forest Park from two to four times each month. From August 1982 to June 1983 less frequent observations were made throughout the park, but with a greater emphasis on bats.

In total 1230 trap nights and 30 spotlight hours yeilded 38 species, of which five are introduced.

The study area, on the eastern face of the Otway Ranges some 100 to 130 km south west of Melbourne, is situated adjacent to the coast from Anglesea-Aireys Inlet in the east to Kennett River-Cape Patten in the west. Lorne is central to the whole park and much of the early work was centred around that township (see Fig. 1). The park is flanked by the Great Ocean Road to the south and tall open-forest to the north and west. Heath and coastal closed-scrub border the park on the eastern edge; and closed-forest exists in some gullies to the west.

Typically, the western section or Lorne block is characterised by high rainfall tall open-forest dominated by *Eucalyptus globulus* with areas of mixed species dominance and smaller areas of *E. regnans* tall open-forest. Coastally, woodland occurs on ridgetops and closed-scrub on the shoreline. The eastern section or Angahook block is largely lower rainfall *E. obliqua* tall open-forest inland, interspersed with low *E. dives* woodland/heath. Large tracts of *E. sideroxylon* open-forest occur behind the coastal closed-scrub. *E. globulus* tall open-forest occurs at Moggs Creek.

As geographical and detailed vegetation data on the area is well documented by the Land Conservation Council (1976), we will not repeat it here.

This paper is not intended as a fully comprehensive treatment of the mammal fauna of the park; but more as a summary of field survey results and a perspective on the significance of the Angahook-Lorne Forest Park in Victoria.

Note The Angahook block was burnt in its entirety in the horrific severity of "Ash Wednesday" in February, 1983. The Lorne block was only burnt along its eastern edge — Grassy Creek/ Cinema Point west to Erskine Road.

## Methods

Live trapping and spotlighting were the primary survey techniques. Chance sightings, tracks and traces were also important.

Equipment used was as follows:

(i) 50 Elliott A collapsible traps,
(ii) 25 cage traps, various sizes,
(iii) 2 modified Tidemann and Woodside (1978) collapsible bat traps,
(iv) a modified method of trip-lining dams (Parnaby 1976),
(v) from two to four 6 Volt, 30 Watt spotlights.

Bait used for traps (i) and (ii) was standard peanut butter and rolled oats mixture.

## Results and Discussion

Specimen catalogue numbers refer to specimens lodged with the Museum of Victoria.

Order Monotremata
Family Ornithorhynchidae
1. *Ornithorhynchus anatinus* Platypus
One observed in Cora Lynn Creek in February 1983. Status and distribution in park unknown.

* 85 Clarence Street, West Geelong, 3218
† 13 Helena Street, Highton, 3216.

Family Tachyglossidae

2. *Tachyglossus aculeatus* Short-beaked Echidna

Specimens observed at Mt. Ingoldsby (near Anglesea), Benwerrin, Grey River and Pinchgut Junction (near Aireys Inlet). Distinctive foraging signs of this species indicate that it is widespread but of unknown abundance in the park.

Order Marsupiala

Family Dasyuridae

3. *Dasyurus maculatus* Tiger Quoll

Only one recorded, at Grey River Scenic Reserve on the western edge of the park. The main distribution of *D. maculatus* in the Otway Ranges is in the Beech Forest area of *Eucalyptus regnans* tall open-forest, 40 km to the west of the study area. *D. maculatus* is apparently restricted in range and uncommon to rare in the Angahook-Lorne Forest Park.

4. *Antechinus stuartii* Brown Antechinus

Recorded in all habitats in the west of the park. Females with pouch young were detected in October and November of 1981. Independent juveniles were first trapped in early January 1982. Second only in numbers trapped to *Rattus fuscipes*, *A. stuartii* was apparently widespread and very abundant. C25035♀ C25342♀.

5. *Antechinus swainsonii* Dusky Antechinus

Recorded only from tall open-forest at Cora Lynn, Sheoaks and Mt Cowley. Unlike *A. stuartii*, *A. swainsonii* appeared to be uncommon and restricted. Mainly trapped during daylight hours, the trap sites featured dense, moist leaf-litter and fallen logs, usually associated with *A. swainsonii* habitat.

6. *Antechinus minimus* Swamp Antechinus

Recorded only at Jamieson River mouth, where one was trapped in tussock grassland beneath coastal woodland, and on Eastern View where a roadkill male was found. Despite the fact that only one was caught, the species is likely to be locally abundant in preferred habitat on the coastal scarp (Emison *et al* 1975). Large numbers of the murids *Rattus fuscipes* and *R. lutreolus* were also caught at the Jamieson River location.

Family Peramelidae

7. *Perameles nasuta* Long-nosed Bandicoot

Four individuals recorded. One killed by a dog in Lorne, one seen on outskirts of Lorne, one seen on walking track at Cora Lynn and one seen on road at Mt Cowley. Peramelids were widespread and abundant in the park judging by foraging signs, although markedly less obvious in the eastern section of the park. We suggest that the bulk of foraging signs observed (in the western section of the park) were made by *Perameles nasuta*. *Isoodon obesulus* is probably more abundant in coastal closed-scrub where one was seen.

8. *Isoodon obesulus* Southern Brown Bandicoot

One seen on Great Ocean Road at Monash Gully on western edge of the study area. A roadkill male was found at Aireys Inlet on 21st November, 1982. Numerous dead and live *I. obesulus* were observed in the aftermath of the Ash Wednesday wildfire.

Family Phalangeridae

9. *Trichosurus vulpecula* Common Brushtail Possum

Recorded only at Sheoaks in tall open-forest and Jamieson River mouth in coastal woodland for the western section of the park. In the east recorded at Distillery Creek, Currawong Falls and Pinchgut Junction. The species is normally associated with drier, more open habitats such as occurs in the Angahook block; the occurrences in dense, mesic habitats in the Lorne block is of interest. The species occurs in low numbers at all sites.

Family Petauridae

10. *Petaurus australis* Yellow-bellied Glider

Recorded in tall open-forest, open-forest and woodland throughout the coastal and near coastal areas of the park as far inland as Mt Cowley near Lorne and Peters Hill near Aireys Inlet. The distribution of *P. australis* in the Otway Ranges and its status there is both poorly understood and documented in the literature. Emison *et al* (1975) describe the species as rare and mostly confined to the central Otway range, whilst Craig and Belcher (1980) show it to be confined to Cape Otway and immediately around Lorne. In the study area, this animal was both plentiful and widespread whilst it occurs in virtually all tall open-forest from Moggs Creek to points west of Cape Otway. Adjacent areas of open-forest and woodland are utilised for foraging by this highly mobile species. Particularly high densities of feed trees were found in the Grey River Scenic Reserve and Jamieson River mouth areas, whilst feed trees were also found at Sheoaks, Cora Lynn, Wye Plantations, Mt Cowley, Benwerrin and Moggs Creek. Typically, *P. australis*-rich tall open-forest is co-dominated by *Eucalyptus cypellocarpa* and *E. globulus;* other common species are *E. obliqua, E. regnans* and *E. viminalis.* Thus, we believe that *P. australis* is much more widespread and abundant in the Otway Ranges, including the study area, than is currently thought. Feed trees in the Moggs Creek area, near Aireys Inlet; a forest severely burned on Ash Wednesday, have not been reworked since the fire. It is feared that this out-lying population may now be extinct.

11. *Petaurus breviceps* Sugar Glider

One recorded in tall open-forest at Grey River Scenic Reserve and one in coastal woodland at Jamieson River mouth. Abundant in open-forest at Distillery Creek-Currawong Falls in Angahook block. The only *P. breviceps* observed in the Lorne block was spotlighted at Grey River while it was feeding at an active *P. australis* sap site four metres above the ground. The Jamieson River animal was recorded on the basis of calls heard. Due to the difficulties associated with detecting *P. breviceps* in dense vegetation, it was not possible to determine their abundance.

12. *Pseudocheirus peregrinus* Common Ringtail Possum

Recorded in all habitats throughout park. *P. peregrinus* was apparently the most abundant petaurid in the study area.

Family Burramyidae

13. *Acrobates pygmaeus* Feathertail Glider

One recorded in tall open-forest at Mt Cowley prior to this survey (Conole 1980). This sighting was made two years before the commencement of this survey and no further observations were recorded.

Family Phascolarctidae

14. *Phascolarctos cinereus* Koala

Recorded at Grey River-Kennett River in the west; and Distillery Creek in the east. Both populations were founded by liberations of Western Port animals by the Fisheries and Wildlife Division (Emison *et al* 1975, Slykhuis pers. comm.). The population at both locations is apparently small — the Distillery Creek colony became extinct on Ash Wednesday.

Family Vombatidae

15. *Vombatus ursinus* Common Wombat

*V. ursinus* is presumed extinct in the Otway Ranges (Emison *et al* 1975). A juvenile animal observed on the Mt Sabine Road in late 1982, and subsequently discovered dead after Ash Wednesday in 1983, is presumed to be an escaped or dumped "pet".

Family Macropodidae

16. *Potorous tridactylus* Long-nosed Potoroo

One recorded prior to survey at Cora Lynn. During survey recorded at Mt Defiance, Mt Cowley, Jamieson River mouth, Sheoaks and Cinema Point. It would appear that *P. tridactylus* is widespread in the Lorne block, although of unknown abundance. The species is numerous enough in the Anglesea-Aireys Inlet area to be a hindrance to the trapping of other small mammals (B. Wilson and K. Kentish pers. comm.).

17. *Wallabia bicolor* Swamp Wallaby

Low numbers recorded throughout the park in tall open-forest, open forest and woodland. The species is regarded as having become locally less abundant in the Lorne block over the last ten years (G. Gayner pers. comm.); but this may be related to road shyness in relation to increased vehicle traffic on forest roads. *W. bicolor* was observed most frequently in the vicinity of logging coupes in Lorne block type vegetation, and in treeless heath/heath woodland in Angahook.

18. *Macropus giganteus* Eastern Grey Kangaroo

Not recorded until July 1982 in the Lorne block, when up to ten animals were seen between Mt Cowley and Erskine Road on the Benwerrin-Mt Sabine Road. The species was not recorded coastally in the western section and almost certainly does not occur there — although it is widespread and abundant from the coast to inland of the eastern section. The animals seen along the Benwerrin-Mt Sabine Road occur on farmland and fire-breaks in dense, mesic tall open-forest; and a local farmer commented that they travel to this area in winter along forest roads and windrows from pastoral country to the north around Deans Marsh and Barwon Downs.

19. *Macropus rufogriseus* Red-necked Wallaby

Emison *et al* (1975) and local naturalists (Pescott and Gayner pers. comm.) regard *M. rufogriseus* as being rare to uncommon and of restricted range in the eastern Otway Ranges. Our work, and that of Kentish (1983) indicate that *M. rufogriseus* is both widespread and abundant from Anglesea to Kennett River. Occurring mainly in open-forest and woodland, the species also inhabits mesic tall open-forest at Grey River. Based on chance sightings on roads, *M. rufogriseus* would appear to be approximately 3-4 times as abundant as *W. bicolor* throughout the park, and approximately as abundant as *M. giganteus* in the Angahook block. This is an important finding of the survey.

Order Chiroptera

Family Molossidae

20. *Tadarida australis* White-striped Mastiff-bat

The characteristic low frequency echolocation calls of this species enabled us to record its presence throughout the entire Angahook-Lorne Forest Park. One was captured at Aireys Inlet. A widespread and plentiful species.

Family Vespertilionidae

21. *Pipistrellus tasmaniensis* Great Pipistrelle

Captured at Aireys Inlet in January 1983, and Moggs Creek in February 1983. The species is almost certainly more widespread than this in the park and is at least locally abundant. On a wider scale, the movements of *P. tasmaniensis* are poorly understood and subject to speculative migration theories. On the basis of our survey results from Aireys Inlet, it is reasonable to assume that the species moved into the area in the time between our last December 1982 trap night and our first January 1983 trap night.

22. *Eptesicus sagittula* Large Forest Eptesicus
Together with *Chalinolobus morio*, *E. sagittula* represents the most widespread, frequently captured species of bat in the eastern Otways (Conole *et al* 1983a). Captured at Mount Cowley, Sheoaks, Aireys Inlet and Moggs Creek in the park, *E. sagittula* is apparently widespread and abundant.

23. *Eptesicus regulus* King River Eptesicus
Widespread but uncommon in the park; *E. regulus* was captured at Cora Lynn, Sheoaks, Grey River and Aireys Inlet C25346 ♂.

24. *Eptesicus vulturnus* Little Forest Eptesicus
Only recorded from Angahook at Aireys Inlet. It is apparent that *E. sagittula* outnumbers both *E. vulturnus* and *E. regulus* but that *E. regulus* is least abundant of all three.

25. *Miniopterus schreibersii* Common Bent-wing Bat
Not formerly known from the eastern Otway coastline, the authors recorded *M. schreibersii* in a limestone sea cave at Cumberland River where 30-100 bats roost at various times of year. The authors also discovered *M. schreibersii* in a sandstone sea cave between Cape Patten and Sausage Gully on the western edge of the park (Conole *et al* 1983b).

26. *Chalinolobus morio* Chocolate Wattled Bat
Captured at Grey River, Wye Plantations, Mount Cowley, Coral Lynn, Sheoaks, and Aireys Inlet. Apparently widespread and abundant. Trapping in the coldest part of winter frequently results in the capture of this species only. C25345 ♂.

27. *Chalinolobus gouldii* Gould's Wattled Bat
Captured at Grey River, Moggs Creek and Aireys Inlet. This species is apparently widespread but of unknown abundance in the Lorne block. It is abundant in Angahook (Conole *et al* 1983a). C25344 ♀.

28. *Nyctophilus gouldi* Gould's Long-eared Bat.
Widespread but apparently uncommon. Captured at Grey River and Aireys Inlet. Observed in flight at Sheoaks and Wye Plantations. This species is restricted to areas of tall open-forest. C25343 ♂.

29. *Nyctophilus geoffroyi* Lesser Long-eared Bat
Only captured in Angahook where it is abundant at Aireys Inlet-Bambra area. Most observations of *Nyctophilus* in flight over roads in the area are attributable to *N. geoffroyi*.

Order Rodentia
Family Muridae
30. *Rattus fuscipes* Bush Rat
Recorded in all habitats throughout the Lorne block. Widespread and abundant on eastern edge of Angahook (Kentish 1983).

31. *Rattus lutreolus* Swamp Rat
One trapped at Cora Lynn in tall open-forest, otherwise coastal in distribution in Lorne block. *R. lutreolus* was very abundant at Jamieson River mouth in coastal tussock grassland. Also abundant in coastal and inland heath in Angahook. Of the two *Rattus* species, *R. fuscipes* was apparently most widespread and plentiful.

32. *Mus musculus* House Mouse
Introduced. One trapped at Jamieson River mouth in Lorne block, common there along Great Ocean Road. A plentiful species on regenerating heaths in Anglesea area to east of park (Kentish 1983).

33. *Hydromys chrysogaster* Water Rat
One observed eating a fish, on bank of Sheoak River near estuary, Lorne block, by J. Slykhuis (Forests Commission). No other observations during survey; status unknown.

34. *Pseudomys fumeus* Smoky Mouse
One captured in coastal heath woodland at Jamieson River mouth; escaped.
This specimen represents only the second recent record of *P. fumeus* for the Otway Ranges. The Bendigo F.N.C. captured an animal at Parker Cove on Cape Otway in 1981; the first in the Otways since Brazenor described the species from Turtons Pass near Beech Forest in the 1930s. Subsequent attempts to recapture *P. fumeus* at Jamieson River have failed.

Order Lagamorpha
Family Leporidae
35. *Oryctolagus cuniculus* European Rabbit
Introduced. Widespread and abundant; observed along most roads in the area.

Order Carnivora
Family Canidae
36. *Vulpes vulpes* Fox
Introduced. Recorded throughout park, abundant.

Family Felidae
37. *Felis catus* Cat
Introduced. Recorded throughout park, abundant.

Order Artiodactyla
Family Cervidae
38. *Cervus elaphus* Red Deer
Introduced. Recorded at Cora Lynn, Allan Dam and Swallow Caves in Lorne block. No deer were seen during the survey, but tracks and rubbing trees were observed and a Geelong deerstalker, Mr Alan Kilpatrick, confirmed that *C. elaphus* occurs in the area. The population is apparently small, and Otway deerstalkers take several each year. Similar tracks and traces at Grassy Creek, the Lorne-Angahook border, are thought to be of *C. unicolor* Sambar Deer (M. Houghton pers. comm.), but these animals are likely to have perished on Ash Wednesday.

The thirty-eight (38) species of mammals recorded during this survey reflects the rich, diverse mammal fauna of the eastern Otways; and the Angahook-Lorne Forest Park in particular. Two similar areas of forest in central highland areas of Victoria had fourteen and twenty species respectively, (Callanan 1981, Deerson *et al* 1975). Noticeably, the park lacks some species typical of some other Victorian forests; *Trichosurus caninus, Petaurus norfolcensis, Petauroides volans, Cercartetus nanus, Sminthopsis leucopus, S. murina, Phascogale tapoatafa, Antechinus flavipes, Pteropus poliocephalus, P. scapulatus, Rhinolophus megaphyllus, Mormopterus planiceps, Myotis adversus, Nycticeius balstoni* spp. complex, *Pseudomys novaehollandiae, P. shortridgei, Mastacomys fuscus, Rattus rattus, Canis familiaris* and *Cervus unicolor.*

However, *Cercartetus nanus* has been recorded adjacent to the park at Anglesea (B. Wilson pers. comm.), Fairhaven (P. Smith pers. comm.) and Moggs Creek (G. McCarthy pers. comm.); *Sminthopsis leucopus* is abundant on heaths adjoining eastern Angahook (Kentish 1983); *Pseudomys novaehollandiae* occurred with the latter species at Anglesea prior to Ash Wednesday (Kentish 1983); *Mastacomys fuscus* was recorded at Benwerrin (Wallis *et al* 1982) and near Mt Cowley (Conole and Baverstock unpubl. data). Many of the other species are eastern or north-western in distribution; some are not coastal. Some species recorded in the park are regarded as rare uncommon and/or restricted in range in Victoria: *Dasyurus maculatus, Antechinus minimus, Pseudomys fumeus* (Bennett 1982).

Some species of mammals not recorded in this survey, but likely to occur locally are: *Myotis adversus* and *Rhinolophus megaphyllus* (Conole *et al* 1983a), *Rattus rattus* and *Cervus unicolor.*

Marine mammals occurring in the sea off the Angahook-Lorne Forest Park coastline were not considered as part of the mammal fauna. These species were recorded: *Physeter catodon, Delphinus delphis, Balaena glacialis, Balaenoptera acutorostrata* and *Arctocephalus pusilla.*

**Conclusion**

This survey was successful in that it recorded the presence of several rare Victorian mammals in the reserved forest: *Dasyurus maculatus, Antechinus minimus* and *Pseudomys fumeus;* and also clarified and expanded the known range and status of the remaining 35 species.

In conclusion the authors state that the Angahook-Lorne Forest Park has a rich and diverse mammal fauna of major significance in Victoria. The area should be regarded as vital to the conservation of a continuing healthy mammal population in south-western Victoria in particular.

**Acknowledgements**

To the late Mr Bert Alsop of Lorne for his interest and support.

To Ms Joan Dixon, Mr Peter Menkhorst, Dr Geoff Brand, Dr Graeme Suckling and the editorial committee of *Victorian Nat.* for their helpful comments during the preparation of this paper.

To Mr John Seebeck, Mr Bob Warneke, Mr John Slykhuis, Mr Geoff Gayner and Mr Alan Kilpatrick for information and ideas.

To the Forests Commission of Victoria and Geelong District Forester, Mr Richard Stone, for approving and supporting the survey.

To the following participants in field work: Kathryn Kentish, Megan Kentish, Ros Jessop, Fredy Mercay, Trevor Lumb, Ray Baverstock, Michael Conole, Don Francis, Dot Francis, Peter Francis, Geoff Brand, Barrie Sheppard, Peter Harrison and Paul Moore.

Protected species of mammals were handled under the provisions of scientific permits issued by the Fisheries and Wildlife Division, Victoria.

REFERENCES

Bennett, A. (1982). A Preliminary Evaluation of the Effect of Intensive Timber Harvesting on the Fauna of the Otway Region South-western Victoria, *A.R.I. Technical Report Series, Tech. Rep. 1*

Callanan, B. A. (1981). Mammals of the Wallaby Creek Catchment, *Victorian Nat. 98:* 109-119.

Conole, L. (1980). A record of the Feather-tailed Glider for the Mount Cowley area of the Otway Ranges, Victoria, *Geel. Nat. 17:* 7-8.

Conole, L. F. and Baverstock, G. A. (1983a) Microchiropteran Distribution in the Otway Ranges, Victoria. Ecological Society of Australia/Australian Mammal Society *Symposium of the Wet-Dry Tropics*, May 1983, Darwin.

Conole, L. F. and Baverstock, G. A. (1983b). Bats in the Geelong Otway District: A brief discussion of present knowledge and future work, *Geel. Nat. 20:* 43-7.

Craig, S. A. and Belcher, C. A. (1980). A technique for live-trapping the Yellow-bellied Glider *Petaurus australis;* with notes on the biology of the species, *Victorian Nat. 97:* 205-10.

Deerson, D., Dunn, R., Spittal, D., and Williams, P. (1975). Mammals of the Upper Lerderderg Valley, *Victorian Nat. 92:* 28-43.

Emison, W. B., Porter, J. W., Norris, K. C. and Apps, G. J. (1975). *Ecological Distribution of the Vertebrate Animals of the Volcanic Plains-Otway Range Area of Victoria,* Fisheries and Wildlife Paper No. 6

Kentish, K. M. (1983). Mine Rehabilitation A Study of Revegetation and Fauna Return at Anglesea, Victoria (1980-1982), Unpubl. MSc Thesis, Deakin University.

Land Conservation Council of Victoria, (1976). *Report on the Corangamite Study Area,* Government Printer, Melbourne.

Parnaby, H. (1976). Bat Survey of the Daylesford Area, Victoria, *Victorian Naturalist. 94:* 191-7.

Tidemann, C. R. and Woodside, D. P. (1978). A collapsible bat-trap and a comparison of results obtained with the trap and mist nets, *Aust. Wild Res. 5*(3): 355-62.

Wallis, R. L., Brunner, H. and Menkhorst, P. W. (1982). Victorian Field Studies of the Broad-toothed Rat (*Mastacomys fuscus* Thomas), *Victorian Nat. 99:* 12-21

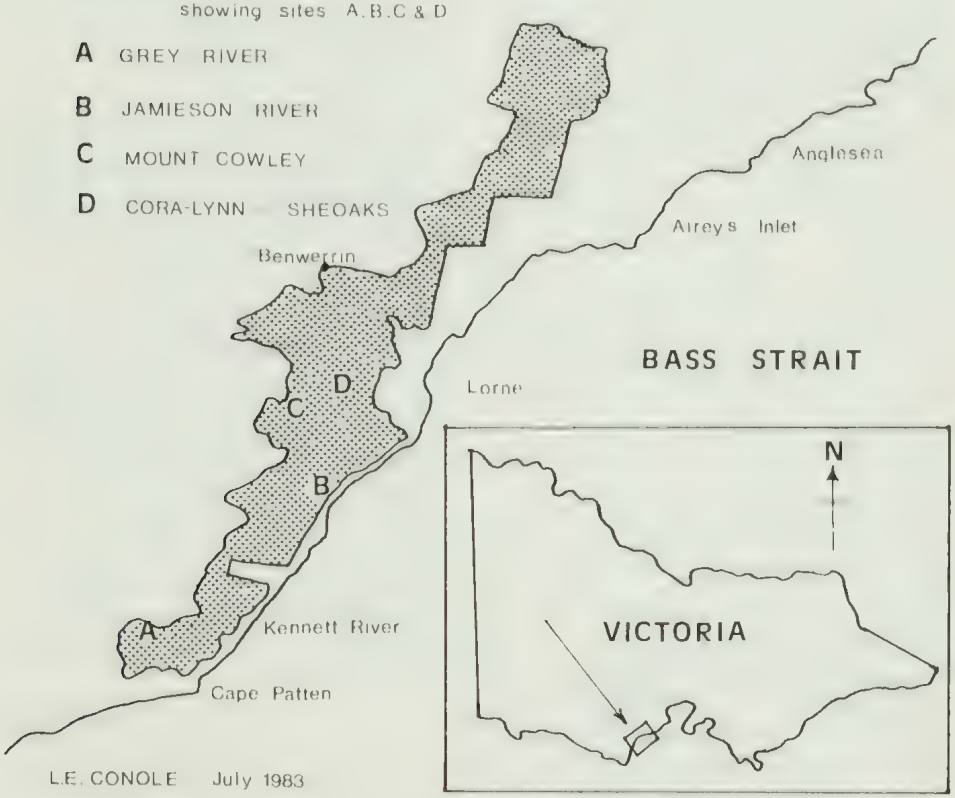
APPENDIX 1

Summary Table Mammals of the Angahook-Lorne Forest Park

| | |
|---|---|
| *Ornithorhynchus anatinus* | *S* |
| *Tachyglossus aculeatus* | *W,S* |
| *Dasyurus maculatus* | *R,U* |
| *Sminthopsis leucopus* | *N* |
| *Antechinus minimus* | *R,U* |
| *A. stuartii* | *W,V* |

| | | | |
|---|---|---|---|
| *A. swainsonii* | *R.U* | *Myotis adversus* | *N* |
| *Perameles nasuta* | *W.A* | *Rhinolophus megaphyllus* | *N* |
| *Isoodon obesulus* | *R.A* | *Rattus fuscipes* | *W.V* |
| *Trichosurus vulpecula* | *W.U* | *Rattus lutreolus* | *R.V* |
| *Petaurus australis* | *W.A* | **Rattus rattus* | *N* |
| *P. breviceps* | *W.S* | **Mus musculus* | *R.A* |
| *Pseudocheirus peregrinus* | *W.V* | *Hydromys chrysogaster* | *R.S* |
| *Acrobates pygmaeus* | *W.S* | *Pseudomys fumeus* | *R.S* |
| *Cercartetus nanus* | *N* | *P. novaehollandiae* | *N* |
| **Phascolarctos cinereus* | *R.U* | *Mastacomys fuscus* | *N* |
| **Vombatus ursinus* | *S* | **Oryctolagus cuniculus* | *W.I* |
| *Potorous tridactylus* | *W.S* | **Vulpes vulpes* | *W.I* |
| *Macropus giganteus* | *W.A* | **Felis catus* | *W.I* |
| *M. rufogriseus* | *W.A* | **Cervus elaphus* | *R.S* |
| *Wallabia bicolor* | *W.U* | **C. unicolor* | *N* |
| *Tadarida australis* | *W.A* | | |
| *Pipistrellus tasmaniensis* | *R.A* | *LEGEND* | |
| *Eptesicus sagittula* | *W.A* | *W* — *widespread* | |
| *E. regulus* | *W.U* | *R* — *restricted* | |
| *E. vulturnus* | *R.U* | * — *introduced* | |
| *Chalinolobus gouldii* | *W.A* | *V* — *very abundant* | |
| *C. morio* | *W.A* | *A* — *abundant* | |
| *Miniopterus schreibersii* | *R.A* | *U* — *uncommon* | |
| *Nyctophilus gouldi* | *W.U* | *S* — *status unknown* | |
| *N. geoffroyi* | *W.A* | *N* — *not yet recorded, may occur* | |

**Fig. 1** Map of study area showing sites A.B.C & D



# Tadarida

*"Like a Fred Williams landscape",*
*they said of Angahook Forest Park,*
*after 'Ash Wednesday',*
*"just sticks, eerie coloured,*
*out of charred surfaces."*

*Not so the forest I knew*
*when one warm summer evening*
*two zoologists worked*
*by a fire dam high in the Otways*
*to set their trap,*
*threading fine filaments of fish-twine —*
*invisible even to bat ears —*
*back and forth*
*from bank to bank across water*
*which reflected, then,*
*Mountain Ash and Manna Gum proudly crowned*
*and understorey tangled and alive.*

*How determined they were*
*to beat the falling light*
*as flicks of bat flight*
*began to pattern the sky spaces*
*in the canopy above;*
*intent to weave a web*
*that would foul sure bat wings*
*and leave the thirsty night hunters helpless,*
*splashed down — easy prey*
*for an eager bat-catcher's handnet.*

*Intent, too, on Tadarida:*
*White-Striped Mastiff-Bat,*
*their king of bats, the 'big flier',*
*catch of catches!*

*Then when night came*
*the flutter of bat wing, then splash,*
*told the tale*
*and sent a flurry of handnets*
*to scoop up the prize:*
*a score of bats — Pipistrelle,*
*Chocolate Wattled, Long-eared,*
*Gould's Wattled and Eptesicus.*

*But no Tadarida,*
*for the grip of surface tension*
*was no match for the beat of his wings —*
*taut skin stretched from blood-surged limbs, which,*
*twice in the night*
*ripped the air past our ears*
*like screaming calico.*

*But then, late, beyond moonset*
*when the air was heavy and insect-laden,*
*a flutter,*
*then splash, louder to keen ears*
*brought a rush.*
*Something was down!*

*He was netted!*

*The Dog Bat!*
*heavy with the night's gorge*
*was enclosed in a jubilant hand*
*under an excited torchlight —*
*night's surreal raider,*
*with sculptured ears over-arching, like eyebrows,*
*a piggy nose and beady fish-egg eyes,*
*an ant wing lolling from a greedy, sullen*
*mastiff mouth below.*

*Later, much excitement later,*
*Tadarida,*
*one-time dweller in Pharoah's tomb,*
*but now indifferent to present indignity,*
*was sexed, measured, and photographed,*
*then released upon the night*
*by a hand unaware of an ordeal to come by day*
*that would be quick,*
*and final.*

*Barrie Sheppard*

# A Brief Survey of Ants in Glenaladale National Park, with particular reference to Seed-harvesting

By Alan N. Andersen*

## Introduction

Although ants are such a conspicuous and apparently important feature of the Australian landscape, Australian ant communities are poorly known. This is highlighted by a marked paucity of published surveys describing the species composition of sites. Such surveys are necessary for the recognition of patterns of species diversity and composition, leading ultimately to the identification of factors determining community structure.

Ants are important components of terrestrial ecosystems in many ways (Andersen, 1983b), one of which is the habit of some species to collect seeds from the ground and take them to their nests for consumption. Although this seed-harvesting activity is restricted to a relatively small proportion of species (in Victoria, notably those belonging to the genera *Pheidole, Chelaner, Monomorium* and *Rhytidoponera),* most sites appear to support several harvester species. There is a general trend for harvester ants to become more abundant with increasing aridity, and they often dominate the ant communities of arid zones (Briese 1982, Davison 1982). Their abundance, high rates of activity and pervasive foraging indicate that they destroy large quantities of seeds and therefore may substantially influence plant reproductive success.

This paper describes the results of a brief survey of ants in Glenaladale National Park, with particular reference to seed-harvesting species, conducted by senior ecology students in the School of Botany, Melbourne University. The ants were surveyed by pitfall trapping, a common and reasonably effective method used to sample ant communities (Andersen 1983a), and seed-harvesting was investigated by monitoring the removal of seeds placed on the ground. The Park is located 30 km northwest of Bairnsdale in eastern Gippsland, in the Upper Devonian foothills of the Great Dividing Range (Fig. 1). Average annual rainfall is approximately 615 mm, distributed evenly throughout the year, and the climate is mild. The vegetation ranges from gully rainforest, through open forests of *Eucalyptus cypellocarpa* and *E. globulus* ssp. *bicostata,* to various eucalypt associations (chiefly *E. globoidea, E. sieberi, E. polyanthemos* and *E. melliodora)* on the adjacent slopes. The gully forest is dominated by


Fig. 1 Location of study sites (x) at Bull and Woolshed Creeks in eastern Gippsland

* Botany School,
University of Melbourne
Parkville 3052


Fig. 2. Vegetation profile and location of study sites (A-E) along Bull Creek transect.
Am — *Acacia mearnsii;* Ao — *Acronychia oblongifolia;* Ar — *Acacia rubida;*
As — *Acmena smithii;* Bp — *Brachychiton populneus;* Ct — *Cassinia trinerva;*
Eg — *Eucalyptus globus;* Em — *E. melliodora;* Pa — *Pomaderris aspera;* Ti — *Tristania laurina.*

Lilly Pilly *(Acmena smithii)* and Kanooka *(Tristania laurina)* and represents the most southerly and westerly extension of the Australian warm temperate rainforest flora.

The study was conducted in the gullies and adjacent slopes of Bull and Woolshed Creeks, near their junctions with the Mitchell River (Fig. 1). The last major bushfire in the area was in February 1965; Bull Creek was completely burnt whereas Woolshed Creek was largely undamaged. The study was conducted during early March 1983, generally a period of high ant activity (Andersen 1983a).

**Methods**

**Bull Creek:** Five sites (A-E) were located along an 80 m transect laid across Bull Creek, 120 m from its junction with the Mitchell River. The transect ran from *E. melliodora* woodland on the north-facing slope, through regenerating gully forest, and into open forest on the south-facing slope (Fig. 2). At each site five pitfall traps (3.5 cm diam.; containing 70% ethanol) and five seed-removal stations were established along a line perpendicular to the transect. Pitfall traps and seed-removal stations alternated with each other, with 1 m spacing. Two *Casuarina pusilla* and two *Eucalyptus baxteri* seeds were placed on the ground at each station, and the numbers of seeds remaining after 48 hrs were recorded. There was insufficient rain or wind to disturb the seeds during this time. The pitfall traps were operated over the same period (1-3 March 1983). *C. pusilla* and *E. baxteri* are not found in the area, but were known to be removed by harvester ants elsewhere (Andersen 1982 and unpublished data).

**Woolshed Creek.** Three sites were established at Woolshed Creek — gully rainforest, *E. polyanthemos* woodland, and the rainforest-woodland ecotone (Fig. 3). At each site eight pitfall traps (1 m spacing) were established in a line parallel to the gully. They were operated from mid-morning on 2 March until late afternoon the following day. Seed-removal was not investigated.


Fig. 3. Woolshed Creek study sites
1. *E. polyanthemos* Woodland
2. Rainforest — woodland ecotone
3. Gully rainforest

**Results and Discussion**

A total of 26 species from 16 genera were recorded from pitfall traps (Table 1). The most abundant were species of *Rhytidoponera (Rhytidoponera confusa* and *R. tasmaniensis)* and *Pheidole* (three unidentified species); both genera are abundant and widespread throughout Australia. The important Australian genus *Iridomyrmex* was also well-represented, with five species recorded, and other abundant ants included species of *Monomorium, Solenopsis* and *Paratrechina.* This is by no means a complete species list, since many species may not have been active at the time (cf. Andersen 1983a), many rare species may not have been recorded, and arboreal and hypogaeic species were not sampled.

There were marked site differences in ant community structure, and these differences showed consistent patterns according to site moisture status. The communities of the more mesic sites (Bull Creek sites C-E and Woolshed Creek rainforest) were all diminated by *Rhytidoponera confusa* and were less diverse than those of the drier sites (Bull Creek sites A, B, and Woolshed Creek woodland). Most species appeared to show a restricted distribution and could be classified as either 'mesic' species (e.g. *R. confusa* and *Iridomyrmex ? foetans)* or 'dry' species (e.g. *R. tasmaniensis, Monomorium* sp. B, *Pheidole* spp. A and B, *Melophorus* spp. A and B, *Notoncus* sp. and *Iridomyrmex* sp. A). Only *Pheidole* sp. C and *Solenopsis* sp. were widely distributed across sites. It is not known to what extent these distributions are influenced by habitat properties (such as soils, vegetation or microclimate) or by interspecific interactions (such as competition with dominant species).

A total of five harvester ants were recorded — *R. tasmaniensis, Monomorium* sp. A, and three species of *Pheidole* (Table 1). Only two of these *(Monomorium* sp. A and *Pheidole* sp. C) were found at the mesic sites, and neither were abundant there. By contrast, with the exception of *Monomorium* sp. A, all were found at the drier sites, where they were often abundant. This distribution of harvester ants matched closely the rates of seed-removal (Table 2). Seed-removal was particularly high (100%) at site B, where *R. tasmaniensis* and *Pheidole* spp. were all abundant. These results suggest that the general trend of increasing harvester ant abundance with increasing aridity may exist within, as well as across, geographical regions.

**Acknowledgements**

I wish to thank the National Parks Service for permission to work in the Park, Dr D. H. Ashton for reading the manuscript, Ms Bronwyn Myers for supplying the photograph used in Fig. 3, and Dr R. W. Taylor for identifying the ant species.

**Table 1.** Ants recorded in pitfall traps. Bull Creek and Woolshed Creek data represent the pooled results of five and eight traps over 48 hrs., and 30 hrs., respectively at each site. Seed-harvesting species are underlined.

| | BULL CREEK | | | | | | WOOLSHED CREEK | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | Total | Wood-land | Eco-tone | Rain-forest | Total |
| sub-family PONERINAE | | | | | | | | | | |
| *Heteroponera imbellis* | 1 | 2 | | | | 3 | | | | |
| *Rhytidoponera confusa* | | | 3 | 14 | 12 | 29 | | 29 | 24 | 53 |
| *R. tasmaniensis* | 1 | 9 | | | | 10 | | 9 | | 16 |
| sub-family MYRMICINAE | | | | | | | | | | |
| *Crematogaster* sp. | 1 | | | | | 1 | | | | |
| *Mayriella abstinens* | | | | | 1 | 1 | | | | |
| *Monomorium* sp.A | | | 3 | 1 | | 4 | | | 2 | 2 |
| *Monomorium* sp.B | 5 | 11 | | | | 16 | 6 | | | 6 |
| *Pheidole* sp.A | 11 | 8 | 1 | | | 20 | 5 | | | 5 |
| *Pheidole* sp.B | | 18 | | | | 18 | | | | |
| *Pheidole* sp.C | 6 | 4 | 2 | 15* | 1 | 28 | | 3 | 1 | 4 |
| *Solenopsis* sp. | 2 | | 15 | 4 | | 21 | | | 1 | 1 |
| *Strumigenys perplexa* | | | | | | | | | 1 | 1 |
| sub-family FORMICINAE | | | | | | | | | | |
| *Camponotus consobrinus* | | 1 | | | | 1 | | | | |
| *Melophorus* sp.A | 1 | 4 | | | | 5 | 4 | | | 4 |
| *Melophorus* sp.B | | | | | | | 4 | | | 4 |
| *Notoncus* sp. | 4 | 1 | | | | 5 | 5 | | | 5 |
| *Paratrechina* sp. | | 15 | | | | 15 | | | | |
| *Prolasius* sp.A | | | | 3 | | 3 | | | | |
| *Prolasius* sp.B | | 1 | | | | 1 | | | | |
| *Stigmacros* sp.A | 2 | | | | | 2 | | | | |
| *Stigmacros* sp.B | 2 | | | | | 2 | | | | |
| sub-family DOLICHODERINAE | | | | | | | | | | |
| *Iridomyrmex foetans* | | | | | 3 | 3 | | | 6 | 6 |
| *Iridomyrmex glaber* | 1 | | | | 1 | 2 | | | | |
| *Iridomyrmex* sp.A | | 7 | | | | 7 | 10 | | | 10 |
| *Iridomyrmex* sp.B | | | | | | | | 11 | | 11 |
| *Iridomyrmex* sp.C | | 3 | | | | 3 | | 4 | | 4 |
| TOTAL no. individuals | 37 | 84 | 24 | 41 | 14 | 200 | 41 | 56 | 35 | 132 |
| no. species | 12 | 13 | 5 | 7 | 3 | 23 | 7 | 5 | 6 | 15 |

* almost all recorded in a single trap

**Table 2.** Percent removal of seeds placed on the ground at Bull Creek.

| SITE | A | B | C | D | E | TOTAL |
|---|---|---|---|---|---|---|
| *Casuarina pusilla* | 60 | 100 | 50 | 10 | 20 | 48 |
| *Eucalyptus baxteri* | 80 | 100 | 80 | 60 | 40 | 72 |
| TOTAL | 70 | 100 | 65 | 35 | 30 | 60 |

REFERENCES

Andersen, A. N. (1982). Seed removal by ants in the mallee of northwestern Victoria. In R. C. Buckley (ed.) *Ant-plant interactions in Australia* The Hague, Junk, pp. 31-43.

Andersen, A. N. (1983a). Diversity and temporal distribution of ants in the mallee of northwestern Victoria. *Aust. J. Ecol.*

Andersen, A. N. (1983b). An introduction to ants. *Victorian Nat. 100:* 188-195.

Briese, D. T. (1982). Relationship between the seed-harvesting ants and the plant community in a semi-arid environment. In R. C. Buckley (ed.) *Ant-plant interactions in Australia.* The Hague, Junk, pp. 11-24.

Davison, E. A. (1982). Seed utilization by harvester ants. In R. C. Buckley (ed.) *Ant-plant interactions in Australia.* The Hague, Junk, pp. 1-6.

## Shell Fish Protection Regulations

As mentioned in the last issue of the *Victorian Nat.*, legislation was enacted in August to prohibit collecting of most molluscs and crustacea from the intertidal zone. The Regulations at first seemed to prohibit collection from anywhere along the Victorian coastline. However, the Minister for Conservation, Forests and Lands has since stated in Parliament that the Regulations will not be enforced until a list of "recognized shell fish habitats" is drawn up and widely publicised.

A group within the Fisheries and Wildlife Division is currently identifying areas at risk of over-exploitation, so that "Recognized Shell Fish Habitats" can be designated. Naturalists can help the Division by identifying coastal or estuarine areas under threat. Details should be sent to Mr Don Buckmaster, Fisheries and Wildlife Division, 250 Victoria Parade, East Melbourne, 3002. Please give your information as soon as possible so that these areas can be "recognized" before the holiday season.

Address any other comments about the legislation to the Minister.

**J. U. PHILLIPS**

## Subscriptions

Subscription rates for 1984 have been increased. This has been necessary because the rate is based on the cost of production and mailing of *The Victorian Naturalist*, to which is added a membership fee of $3, which is applicable to both partners in a joint membership. A higher rate applies to Metropolitan members who have the opportunity of attending meetings. Council hopes that by making a considerable increase in the rates now it will be possible to absorb increasing costs without having to raise the subscription rates again in the near future.

Council draws members' attention to the following points:

Subscriptions cover the calendar year from January to December.

Persons joining the Club in the second half of the year may pay a 6 month or 18 month subscription. Anyone paying a full year's subscription in the second half of the year will be regarded as having paid for the **current year** and will receive back issues of that volume of *The Victorian Naturalist.*

Subscriptions do **not** run from mid-year to mid-year.

In order to cut costs Council has discontinued the practice of sending individual reminder notices.

Members who fail to renew their subscriptions by 15th May will have their names automatically removed from the mailing list.

Prompt payment greatly facilitates the Club's operations.

# Notes on the Biology and Distribution of a Rare Jewel Beetle *Pseudotaenia waterhousei* (Van de Poll) (Coleoptera: Buprestidae).

By T. J. Hawkeswood*

**Abstract**

Notes on the general biology and distribution of *Pseudotaenia waterhousei* (Van de Poll) (Buprestidae) are described from material collected from the Dunmore State Forest, central south-east Queensland (c. 27°40'S, 150°50'E). The beetle is very rare and nearing extinction. Recommendations for conservation of the species in Queensland are proposed.

**Introduction**

The genus *Pseudotaenia* Kerremans belongs to the sub-family Chalcophorinae, tribe Chalcophorini (Buprestidae) (Carter, 1929) and contains eight species (Carter, 1921, 1929). The genus is endemic and mainly found in drier areas of northern Australia. Adults are large metallic, blue to blue-green beetles, 30-45 mm in length, and often adorned with a yellow powdery substance resembling pollen. As is the case with other genera of the Australian Chalcophorinae (i.e. *Chrysodema* Laporte & Gory, *Chalcotaenia* Deyrolle, *Cyphogastra* Deyrolle, *Iridotaenia* Deyrolle and *Paracupta* Deyrolle), specimens of *Pseudotaenia* Kerremans are rare in museum collections and little is known of their biology. Hence any detailed studies of any members of the group should add significantly to present knowledge.

Recent field work by Mr M. De Baar and his colleagues from the Department of Forestry, Indooroopilly, Brisbane, has resulted in the location of a small population of *P. waterhousei* (Van de Poll) (Fig. 1). Since the species appears not to have been collected from this area of Queensland for over 45 years, the last specimens being from Chinchilla in 1937, De Baar's collections virtually represent a rediscovery of the taxon. The enthusiasm shown by Messrs De Baar and M. Hockey has prompted the author to provide details on our present knowledge of the biology and distribution of the species.

**Notes on adult behaviour**

The following notes were provided by De Baar from observations and collections he made in the Dunmore State Forest via Dalby (c. 27° 40'S, 150° 50'E) during December 1980. Adults of *P. waterhousei* were usually found resting about one metre above ground level on the main trunks of *Acacia leiocalyx* (Domin) Pedley (Mimosaceae). No adults were observed on the minor branches or leaves. The beetles were particularly active in hot weather (30-35°C) and if disturbed, usually flew upwards and landed on the tops of nearby trees (other than *Acacia*) and later returned to the trunks of *A. leiocalyx*. When in flight adults produced a loud buzzing sound. Although species of *Eucalyptus* and *Angophora* (both Myrtaceae) were flowering at the time and attracted numerous beetles including other Buprestidae, no *P. waterhousei* were observed visiting the blossoms. *Acacia leiocalyx* was not flowering at the time. Many buprestids are obligate leaf-feeders, but feeding of *P. waterhousei* on *Acacia* leaves was not observed. Some females were observed ovipositing in fissures in the *Acacia* trunks.

These observations suggest that adults do not feed on flowers or nectar of *A. leiocalyx* and probably do not feed on

* Department of Botany, University of Queensland, St. Lucia, Brisbane, 4067, Queensland

*Acacia* leaves either. Many insects which do not feed in the adult stage have short adult life-spans. It is most likely that the life-span of the adult *P. waterhousei,* after emergence from the host timber, is short, i.e. 10 days or less. One to two weeks after emergence is the average adult life-span of some Australian buprestids (Hawkeswood, 1975-77, unpublished data). All stages of this beetle's life-cycle are strongly associated with *A. leiocalyx,* with egg-laying, and probably mating, being restricted to sites on the main trunks.

Log billets with suspected infestations by beetles, either Buprestidae and/or Cerambycidae, were brought back to the laboratory in Brisbane and three last instar larvae of *P. waterhousei* were obtained from the wood as well as a number of adults. The record of this *Acacia* as a larval host has been previously made from data supplied by De Baar (Hawkeswood and Peterson, 1982, p.242).

**Brief description of the adult** (Fig. 1)

Male and female: Body elongate, robust, large-sized, convex; head, pronotum, scutellum, elytra, legs and undersurface of body dark metallic purple-blue; eyes and antennae black. Pronotum and elytra with metallic green to dark blue reflections; elytra (except


Fig. 1. Adult of *Pseudotaenia waterhousei.* (Photo. M. Peterson).

for costae), pronotum and undersurface, irregularly covered (in fresh examples) in a pollinose material which, on sternites is restricted to the margins. Size: ♂ 40.4 ± 5.0 mm × 13.1 ± 2.0 mm (8 specimens).

♀ 44.4 ± 2.0 mm × 15.8 ± 1.0 mm (5 specimens).

**Distribution**

The collections of *P. waterhousei* in the various Australian museums are somewhat small. In most cases, adult specimens are old, discoloured, worn and without the yellow pollinose material usually present on fresh examples. The collection data accompanying them are usually meagre and often non-existent. However, the data that are available, suggest that the species is confined to central south-east Queensland with a probable extension to central New South Wales. The distribution is shown in Fig. 2.

Details of collections in various institutions are given below. Abbreviations are as follows: — ANIC — Australian National Insect Collection, CSIRO, Canberra; QM — Queensland Museum, Brisbane; QDF — Queensland Department of Forestry, Brisbane; NMV — National Museum of Victoria, Melbourne; SAM — South Australian Museum, Adelaide). There appear to be no collections of *P. waterhousei* in the Western Australian Museum, Perth, the Australian Museum, Sydney or the Queensland Department of Primary Industries Collection, Brisbane.

Museum material: *Queensland:* 2♂ & 1♀, Chinchilla, Jan. 1937, F. A. Cole (QM); 1♀, Chinchilla (NMV); 1♀, Rockhampton (NMV); 1♀, Duaringa (SAM); 4♀ & 7♂, Dunmore State Forest via Dalby, 23 Dec. 1980, F. R. Wylie & M. De Baar (QDF); 1♀, Dunmore S. F., 22 Dec. 1981, M. De Baar & M. Hockey (QDF); 1♀, Dunmore S. F., 31 Jan. 1982, M. J. Hockey (QDF); Emerged material — 1♂, em. 24 Nov. 1980, M. De Baar & F. R. Wylie; 1♂, em. 31 Nov. 1980, M. De Baar & M. Hockey; 1♀, em. 1 Dec. 1980, M. De Baar & M. Hockey; 1♀, em. 8 Dec. 1980, M. De Baar & M. Hockey; 1♂, em. 6 Jan. 1982, F. R. Wylie & M. De Baar (All from the Dunmore State Forest in log billets and now housed in QDF); 1♀ & 1♂, "Qld" (SAM); 5♀, "Qld" (NMV); 2♀ & 1♂, no data (UQ); 1♀, no data (QM); 1♂, E. Sutton coll. (QM).

*New South Wales:* 1♀, Bimbi (ANIC); 1♂ & 1♀, Dubbo (ANIC).

**Conservation**

*P. waterhousei* appears to be a very rare beetle probably destined for extinction unless efforts are made in the near future to preserve it. Its status in previously collected localities, with the exception of the Dunmore State Forest,

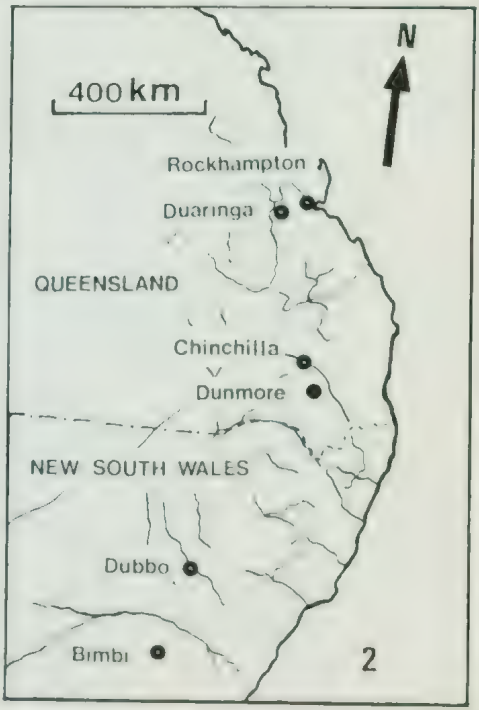



Fig. 2. Distribution of *Pseudotaenia waterhousei* based on museum collections

is not known with any certainty due to lack of recently collected specimens. However, it is likely that the species is now extinct in New South Wales since there are no recent collections from there. The *Acacia* scrubs have been extensively cleared for agriculture for a long period of time, and the specimens in ANIC, the only three known from this State, are extremely old and probably collected late last century or earlier when their habitat, the brigalow zone, was relatively unmodified by Man.

Mr E. E. Adams, a well-known and long-time collector of Coleoptera in the Edungalba-Rockhampton area informs me (1982, pers. comm.) that *P. waterhousei* is almost extinct in that area. It appears that the species was scarce there in the past, probably existing as small, isolated populations, and therefore vulnerable to the effects of large-scale land clearing.

The Chinchilla specimens are also old. Two extensive visits to the Chinchilla — Barakula State Forest area by the author during Nov. 1982 and Jan. 1983, failed to procure any specimens, either alive or dead, although the food plant, *A. leiocalyx* was abundant in several areas. However the weather was dry and hot and there was little rain during the previous winter, weather conditions which were probably not conducive to the emergence of the beetles, if in fact the species does occur there.

My personal view is that *P. waterhousei* is extinct in N.S.W., is nearing extinction in the northern part of its range (Rockhampton area) and is rare and sporadic in the central portion of its distribution (Chinchilla-Dalby area). At Dunmore the species occurs in *A. leiocalyx* thickets on rocky hilltops and slopes, usually away from areas where Callitris Pine *(Callitris columellaris)* (Cupressaceae) are grown and harvested for commercial use. Bush fires, at the moment, would appear to be the main threat to its survival at this locality. However, I would recommend that special areas in which populations are known to occur (i.e. in the Dunmore State Forest), should be set aside as conservation reserves, and further research should be undertaken to locate further populations if they still exist.

**Acknowledgements**

I would like to thank Mr M. De Baar, Department of Forestry, Indooroopilly, Brisbane, for much assistance and for providing material of *P. waterhousei* collected by himself, M. Hockey and F. R. Wylie for me to examine. I gratefully acknowledge the assistance of Dr S. Bílý, Department of Entomology, National Museum, Kunratice, Czechoslovakia, Dr M. Volkovitsh, Zoological Institute, Academy of Sciences of the USSR, Leningrad, USSR, and Mr E. E. Adams, Edungalba via Rockhampton, Queensland, for correspondence and other information. Thanks are expressed to the Curators of ANIC, NMV, QM, SAM, UQ for information or allowing me access to collections in their care. I would like to thank Mr C. E. Chadwick, Australian Museum, Sydney for sending information and specimens of Buprestidae and Mr M. Peterson, Perth, for the photograph of *P. waterhousei*. This research was undertaken on private funds and I would like to thank my mother, Mrs D. E. Hawkeswood for assistance.

REFERENCES

Carter, H. J. (1921). Australian Coleoptera: notes and new species I. *Proc. Linn. Soc. N.S.W. 46:* 301-323.

Carter, H. J. (1929). A checklist of the Australian Buprestidae. *Aust. Zool. 5:* 265-304.

Hawkeswood, T. J. and Peterson, M. (1982). A review of larval host records for Australian jewel beetles (Coleoptera: Buprestidae). *Victorian Nat. 99:* 240-251

# Seed Dispersal of Cockspur *(Maclura cochinchinensis)* (Lour.) Corner by Land Mullet *(Egernia major)*

By J. G. Conran*

**Introduction**

*Egernia major* (Gray) is the largest Australian skink (Scincidae), and is found in south-east Queensland and northern New South Wales (Cogger, 1979), commonly in rainforest where it is colonial. The species is omnivorous, feeding on insects, snails, lizards and fruit (Davey, 1970).

Land Mullet are common on the Springbrook Plateau in south-east Queensland, where they inhabit rainforest and adjacent sclerophyll forests. In these environments, plants with fleshy fruits or arillate seeds are common.

**Methods**

A road-killed specimen of *E. major* from the edge of the Plateau in sclerophyll forest, was collected for examination for parasites in late February, 1983. Dissection of the intestine revealed the presence of 56 seeds of two species (53 of species A and 3 of species B) in the cloacal portion of the colon. The seeds of species A were pale brown with a whole line along the hilum; those of species B were black and conspicuously pitted. The seeds were planted out on moistened filter paper in petri dishes under c.3500 lux (12 hours day length) at 26.4°C and germination recorded.

**Results**

No seeds of species B germinated. However, 3 seedlings (ca. 6%) of species A emerged. After 19 weeks, the seedlings had developed sufficiently to enable identification as *Maclura cochinchinensis* (Lour.) Corner (Moraceae), a spiny climber of rainforest margins from New South Wales to South-west Asia (Beadle, 1976).

The seedlings of *M. cochinchinensis* (Fig. 1) emerged after 43 days under the germination conditions used and were phanerocotylar with ovate, leathery, asymmetric cotyledons 9 mm long and 5 mm wide. The stem, hypocotyl and young leaf margins were finely pubescent with downward slanting hairs. The leaves were shortly petiolate, rhomboid


Fig. 1. Seedling of *M. cochinchinensis*.

* Botany Department, University of Queensland, St. Lucia, Q. 4067

elliptic, with small (c. 0.3 mm) serrate stipules. The first leaf pair were opposite, but subsequent leaves alternate. The fourth leaf supported an axillary spine, as did subsequent leaves.

**Discussion**

The dispersal of seeds by reptiles (saurochory) is not commonly reported for modern plants (van der Pijl, 1982). However, there is fossil evidence to suggest that some angiosperms and Caytoniales were dispersed by reptiles (Weigelt, 1930; Faegri and van der Pijl, 1971). Most present day saurochory involves turtles and tortoises (van der Pijl, 1982; Klimstra and Newsome, 1960). However, a species of *Lacerta* (Scincidae) in the Canary Islands eats the fruits of *Plocama pendula* Air. (Rubiaceae), the seeds being dispersed in its faeces (Barquin and Wildpret, 1975).

In Australia, little is known of saurochory, although a north Queensland *Ficus* is reported to be distributed by an aquatic tortoise (Legler, 1976), and the introduced *Asparagus retrofractus* L. has been found by Clifford and Hamley (1982) to be dispersed by *Physignathus lesueurii* (Gray) (Agamidae). This latter species has also been found to contain viable seeds of *Lantana camara* L. in its stomach (H. T. Clifford pers. comm.). Several other large Australian Agamidae and Scincidae are reported to be omnivorous (Worrel, 1963; Symon, 1979; Swanson, 1976), so that fruit-eating and subsequent seed dispersal may be quite widespread.

Van der Pijl (1982) describes fruits adapted to saurochory as being coloured, borne close to the ground or dropped at maturity, and having an odour. Most of the fruits tend to be berries. However, Beccari (1890) claimed that the arillate seeds of *Durio testudinarius* Becc. (Bombacaceae) were dispersed by turtles. Since reptile/angiosperm relationships were thought to have developed during the early evolution of the angiosperms (Elvers, 1977), it is interesting that many of the plant families eaten by reptiles are those with long fossil histories (van der Pijl, 1982).

*M. cochinchinensis* is in the Moraceae, which is one of the families listed by van der Pijl (1982) as having members with zoochorous fruits. It has syncarpous fruits with c. 6-15 free drupes enclosed by fleshy perianth parts and immersed in the receptacle (Bailey, 1902), which may explain why so many seeds were obtained from the Land Mullet gut. The plant occurs commonly in the forest adjacent to where the Land Mullet was found. The fact that some of the seeds were viable indicates that *E. major* is at least one of the vectors for the dispersal of *M. cochinchinensis*. It is more likely, however, that *M. cochinchinensis* would be mainly dispersed by the many species of fruit-eating birds which occur in the environments in which it occurs, and that dispersal by Land Mullet is a rare and locally restricted event. Certainly the distribution of *E. major* given by Cogger (1979) covers only a small part of the range of *M. cochinchinensis*.

The role of reptiles in present day plant biology is not often appreciated, and often considered to be of little significance when compared to their descendants, the birds. Despite this, reptiles appear to be involved with seed dispersal, and since many Australian plants have fruits conforming to the criteria for saurochory, the condition may be more widespread than has been reported.

**Acknowledgements**

Thanks are expressed to Mr M. Jones of the Parasitology Department, Queensland University, for the dissection of the Land Mullet.

REFERENCES

Bailey, F. M. (1902). *The Queensland Flora V.* (Govt. Printer. Brisbane).

Barquin, D. E. and Wildpret, W. (1975). Disseminacion de plantas canarias. Datas inciales. *Vieraea* (Tenerife) *5:* 38-60.

Beccari, O. (1890). *Malesia 3* Firenze. cit. in Pijl, L van der (1982). *Principles of Dispersal in Higher Plants* 3rd Ed. (Springer-Verlag. Berlin).

Clifford, H. T. and Hamley, T. (1982). Seed dispersal by water dragons. *Qld. Nat. 23 (6):* 49.

Cogger, H. G. (1979). *Reptiles and Amphibians of Australia.* (Reed. Sydney).

Davey, K. (1970). *Australian Lizards* (Landsdowne Press. Melbourne).

Elvers, I. (1977). Flower visiting lizards on Madiera. *Bot. Notiser 30:* 231-4.

Faegri, K. and Pijl, L. van der (1971). *The principles of pollination ecology.* 2nd Ed. (Pergamon. Oxford).

Klimstra, W. D. and Newsome, F. (1960). Some observations on the food coactions of the common Box Turtle *(Terrapene c. caroline). Ecology 41:* 637-647.

Legler, J. M. (1976). Feeding habits of some Australian shortnecked tortoises. *Victorian Nat. 93:* 40-43.

Pijl, L. van der (1982). *Principles of Dispersal in Higher Plants.* 3rd Ed. (Springer-Verlag. Berlin).

Swanson, S. (1976). *Lizards of Australia.* (Angus and Robertson. Sydney).

Symon, D. E. (1979). Fruit diversity and dispersal in *Solanum* in Australia. *J. Adel. Bot. Gard. 1:* 321-331.

Weigelt, J. (1930). Uber die vermutliche Nahrung von *Protosaurus* und uber einer korperlich erhaltenen Fruchstand von *Archaeopodocarpus germanicus* aut. *Leopoldina 6:* 269-280.

Worrel, E. (1963). *Reptiles of Australia.* (Angus and Robertson. Sydney).

# Honeydew, Manna, Scale and Lerp

BY A. L. YEN*

In the last issue of *The Victorian Naturalist,* Mr T. Sault related his observations on the production of manna by scale insects and raised the question of the identity of the biblical manna. This would be an opportune time to elucidate the differences between the terms "honeydew", "manna", "scale", and "lerp", used interchangeably in Australia, but not always correctly.

## Honeydew

This is an excretory product of many species of plant sap-sucking insects belonging to the order Hemiptera. The better known honeydew producers are aphids, coccids and psyllids. Honeydew is excreted as a liquid which may solidify through evaporation. Many of these insects have attendant ants which collect the honeydew.

* Biological Survey Dept., Museum of Victoria, Melbourne.

## Manna

There are at least two definitions of manna being used in Australia. The biblical manna is of uncertain identity, but many believe that it is the globular wind-borne fruiting bodies of a lichen growing on rocks in the Middle East. However, Bodenheimer (1951) disagrees with this interpretation and believes that it is the solidified honeydew of two species of coccids on tamarisk trees. In Australia, the term manna has been applied to various substances ranging from insect excretions to plant secretions. Today the term is being used more synonymously with the latter. It is a plant exudate from the leaves and branches of certain species of eucalypts and angophoras whose production may be initiated by insect attack. It does not pass through the insect but occurs after the injury is suffered. Manna consists of white nodules 1.5-4mm in diameter, but individual nodules can cluster together to form larger lumps (Basden 1965).

**Scale**

This is the protective covering formed from the secretion of some species of coccids. The term has also been applied to the covering produced by some species of psyllids, and this has resulted in psyllids often being mistakenly called "scale insects", a term which should be reserved for coccids.

**Lerp**

The immature stages of some eucalypt feeding psyllid species form a protective covering called a lerp or test. It was described originally from *Eucalyptus dumosa* in the Wimmera region, where it was gathered as food by the Aborigines (Dobson 1851). The name "lerp" is the Aboriginal name. The lerp is produced from honeydew excreted by the psyllids. Not all psyllids build lerps: some produce only honeydew, some honeydew and lerp, and others produce a covering of waxy, flocculent or chitinous material. Lerps consist of plant starch and water, although traces of protein and lipid may be present (Basden 1970, Gilby et al 1976, White 1972). The function of the lerp is uncertain. It does not seem to be effective against predators and parasites, but it may assist in preventing dessication. Lerp production is found predominantly in several genera of eucalypt-feeding Australian psyllids, but a few lerp-forming species have been found in Japan, South Africa, China, North and Central America (Russell 1971).

REFERENCES


Basden, R. (1965). The occurrence and composition of manna in Eucalyptus and Angophora. *Proc. Linn. Soc. N.S.W. 90:* 152-156.

Basden, R. (1970). A note on the composition of the lerp and honeydew of *Eucalyptolyma maidenii* Froggatt. *Proc. Linn. Soc. N.S.W. 95:* 9-10.

Bodenheimer, F. A. (1951). Insects As Human Food. The Hague; W. Junk.

Dobson, T. (1851). On laap, or lerp, the Cup-like covering of Psyllidae found on the leaves of certain eucalypts. *Pap. Proc. Roy. Soc. Van Dieman's Land 1:* 235-241.

Gilby, A. R., McKeller, J. W. and Beaton, C. D. (1976). The structure of lerp: carbohydrate, lipid and protein components. *J. Insect Physiol. 22:* 689-696.

Russell, L. M. (1971). Notes on *Euphalerus nidifex* Schwarz and related nest-making New World psyllids (Hemiptera: Psyllidae). *Fla. Ent. 54:* 3-12.

White, T. C. R. (1972). The production of amylose in the faeces of psyllid larvae with special reference to the lerp of *Cardiaspina densitexta*. *J. Insect Physiol. 18:* 2359-2367.


## World Congress of Herpetology

An international committee has been established to plan the first World Congress of Herpetology. The congress will be organized to include a wide range of topics, and to appeal to everyone interested in the scientific study of amphibians and reptiles. The Planning Committee is seeking comments on all aspects, particularly the choice of a convenient site and content of the congress. The Australian representative on the committee is H. G. Cogger, The Australian Museum, 6-8 College Street, Sydney, 2000.

## Addition to Kinglake Bird List

BY J. L. PROVAN*

One addition to the list of birds observed in the vicinity of the F.N.C.V. property at Kinglake (published in the *Victorian Nat.* March/April, 1983) is the Little Eagle. One of these birds was seen in April, 1983 and again in September, 1983 over the valley to the north-east of the property.

It is interesting to note also that Gang-Gang Cockatoos are back in force in the area this spring. A flock of more than twenty was observed on several occasions early in November in timber near the block.


* 60 Brinsley Road, Camberwell, 3124.

# The Effect of Drought on the Nutrient Levels in Two Creeks in the Western Port Catchment

By I. Dickson*, P. Collins*, L. MacGregor* and P. Theobald*.

Previous studies on the variation of nutrient levels in natural waters in response to drought conditions have shown that there is a significant increase in levels both during and directly following the drought period (Havill, et. al., 1977; Ladle and Bass, 1981 and Walling and Foster, 1978). No such studies have been reported in Australia probably due to the lack of base-line data and suitable droughts.

Walling and Foster (1978) showed that nitrate levels in river water increased dramatically during the onset of rainfall after the 1976 drought in Devon, England. One analysis returned a value that was 45 times greater than the average for that time of year. Similar increases in phosphate levels have been observed after drought (Ladle and Bass, 1981).

In 1980-81 six creeks in the Western Port Catchment area were analysed for a number of chemical and biological parameters by the Environmental Studies Department of Victoria College (Rusden Campus) (Dickson et. al., 1982). Since this period, Victoria has experienced one of the most severe droughts in its recorded history. This situation provided a unique opportunity to investigate the effect of the drought on the phosphate and nitrate levels compared to a non-drought period.

The study area is in the Shire of Hastings (Fig. 1) and the two creeks (Merricks Creek and Watson Creek) were chosen because of their contrasting water quality and surrounding land use. The sampling sites were the same as in the 1980-81 study so that direct comparison could be made.

* Environmental Studies Department, Victoria College (Rusden Campus), Blackburn Road, Clayton, Victoria.

## Methods

Eight sample sites were chosen (1, 3 to 9; Fig. 1) and site descriptions can be found in Dickson, et. al., 1982.

Samples were collected on 25th April and 1st May 1983 from the centre of the creek at a depth of 10 cm in acid-washed polypropylene screw-top bottles. The samples were frozen until analysis.

Nitrate was measured by the ultraviolet spectrophotometric method; orthophosphate by the vanodomolybdatophosphoric acid colourimetric method and sulphate by the turbidimetric method (American Public Health Association, 1976). A Shimadzu model 240 double beam spectrophotometer was used.

## Results

The results for nitrate and orthophosphate levels are shown in Tables 1 and 2. The results of the 1983 study for the sulphate levels are shown in Table 3. The rainfall figures for the area are shown in Table 4.

## Discussion

Merricks Creek drains an area of alluvial swamp deposits and land usage is predominantly grazing with significant areas assigned to forestry. Sites 1 and 3 are surrounded by orchards and improved pastures containing medium to low density residential areas from which septic tank and sullage wastes are emptied into the creek at a rate of 7,000 litres per day (Dickson, et. al., 1982).

Watson Creek also drains a swampland carrying alluvial material consisting mainly of humic clays. Most of the area is low density residential and

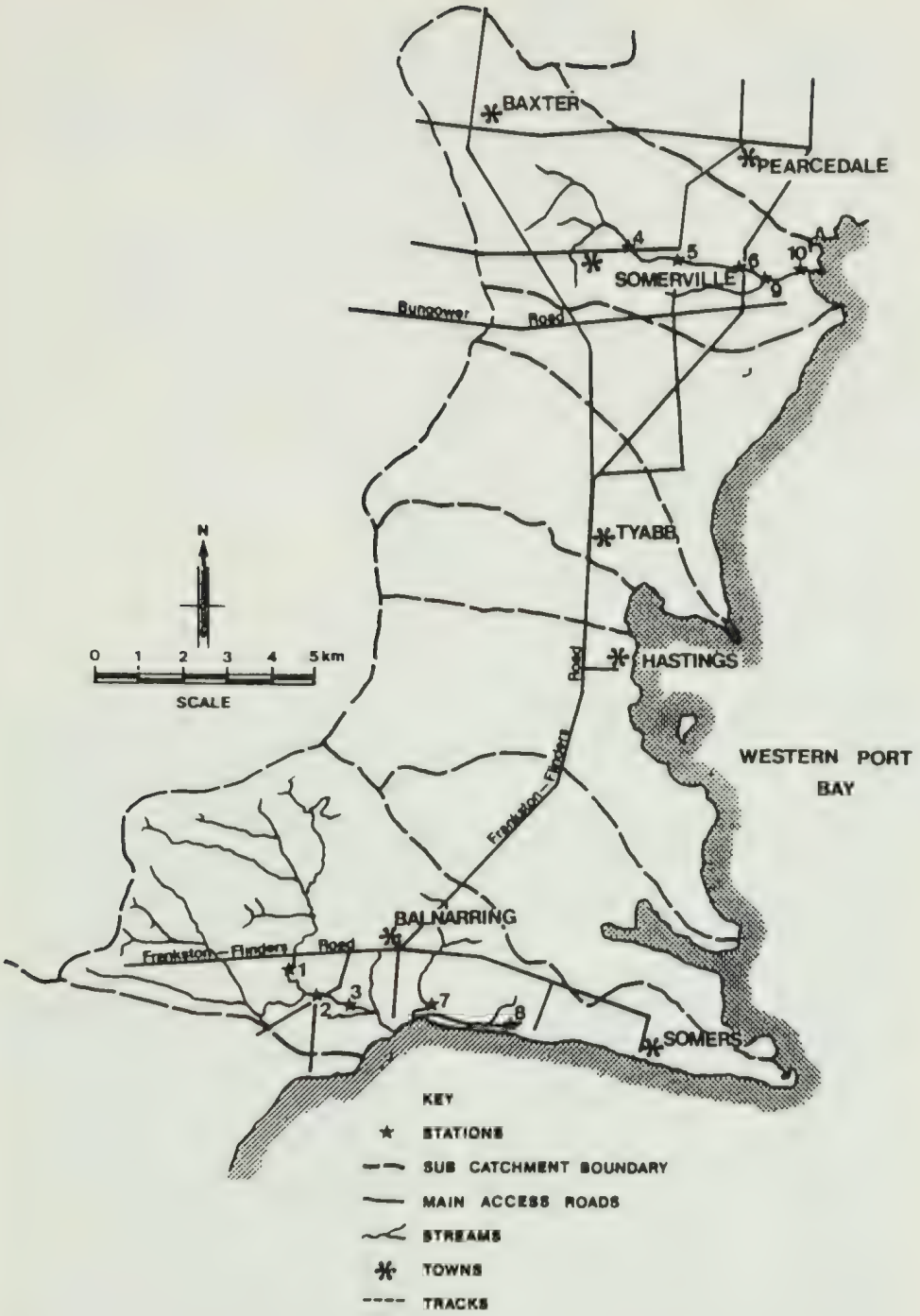



Fig. 1. Merricks (lower) and Watson Creek catchments showing sampling sites (Dickson, et. al., 1982).

Table 1. Orthophosphate concentrations (mg l) in water from eight sampling stations in Merricks (1, 3, 7, 8) and Watson (4, 5, 6, 9) Creeks.

| STUDY SITE | 1980-81 | | | 1983 | | |
|---|---|---|---|---|---|---|
| | Min* | Max* | Mean* | 25-4-83 | 1-5-83 | Mean |
| 1 | 0.01 | 0.04 | 0.03 | 1.95 | 2.35 | 2.15 |
| 3 | 0.01 | 0.09 | 0.09 | 1.95 | 1.76 | 1.85 |
| 7 | 0.01 | 0.07 | 0.02 | 2.00 | 2.04 | 2.02 |
| 8 | 0.01 | 0.07 | 0.02 | 2.46 | 2.04 | 2.25 |
| 4 | 0.01 | 2.53 | 0.83 | 2.25 | 4.75 | 3.50 |
| 5 | 0.35 | 5.90 | 2.08 | 4.26 | 9.50 | 6.88 |
| 6 | 0.19 | 3.55 | 1.45 | 3.05 | 5.85 | 4.45 |
| 9 | 0.30 | 3.00 | 1.07 | 4.05 | 6.46 | 5.31 |

* These figures were drawn from the entire period of the study.

with improved pasture, poultry farming, orchards, market gardening and bushland. Above Site 4 the creek is barrel-drained and below the site considerable sewage and sullage was observed entering the creek. The Golden Poultry Chicken Farm has a pondage system through which all liquid wastes are pumped prior to entering the creek near Site 5.

The drought period was considered to have extended from June 1982 to March 1983 (Table 4). In this period 438 mm of rain fell compared to 672 mm in the previous year. The time of sampling was in late April and early May when appreciable rain had again begun to fall.

The results (Tables 1 and 2) indicate that there is a significant increase in nitrate and phosphate levels over those observed in the 1980-81 study. The increase was greater in Merricks Creek (up to 59 times greater than the highest value observed in the 1980-81 study for orthophosphate and 17 times greater for nitrate) than Watson Creek (2 times for orthophosphate; 3 times for nitrate). This is thought due to the fact that Watsons Creek normally carries a very high nutrient load. The water quality of Merricks Creek deterioriated from very good (1980-81) to where the measured orthophosphate and nitrate exceeded prescribed levels (Dickson et. al., 1982), at all sites immediately after the drought.

The increase in nutrients may be attributed to many factors. The most important is probably the accumulation of these nutrients during the drought period followed by post-drought rainfall flushing of these solutes into the water courses. Walling and Foster (1978) felt that this mechanism alone could not explain the large increases in nitrate levels observed and these may have been boosted by the effect of high temperatures and dry conditions on the biochemistry of the soil especially with the interaction between organic and inorganic nitrogen and the processes of mineralization and nitrification.

Increased nutrient levels after post-drought rainfall may also be attributed to the decreased dilution of input materials, water loss by evaporation and the use of fertilizer during the drought period.

**Conclusion**

The nutrient levels in Merricks and Watson Creeks were significantly higher after post-drought rainfall than before the drought.

**Table 2.** Nitrate Concentrations (mg/1) in water from eight sampling stations in Merricks (1, 3, 7, 8) and Watson (4, 5, 6, 9) Creeks.

| STUDY | 1980-81 | | | 1983 | | |
|---|---|---|---|---|---|---|
| SITE | Min* | Max* | Mean* | 25/4/83 | 1/5/83 | Mean |
| 1 | 0.01 | 0.72 | 0.23 | 1.20 | 1.20 | 1.20 |
| 3 | 0.01 | 0.87 | 0.20 | 2.08 | 2.08 | 2.08 |
| 7 | 0.10 | 0.40 | 0.32 | 5.00 | 2.08 | 3.54 |
| 8 | 0.09 | 1.41 | 0.25 | 4.43 | 4.43 | 4.43 |
| 4 | 0.07 | 3.35 | 1.07 | 7.97 | 7.40 | 7.69 |
| 5 | 0.13 | 5.53 | 2.01 | 16.83 | 14.43 | 15.63 |
| 6 | 0.16 | 8.32 | 2.86 | 13.87 | 15.64 | 14.76 |
| 9 | 0.42 | 5.27 | 2.54 | 4.43 | 3.54 | 3.99 |

* These figures were drawn from the entire period of the study

**Table 3.** Sulphate Concentrations (mg/1) in water from eight sampling stations in Merricks (1, 3, 7, 8) and Watson (4, 5, 6, 9) Creeks.

| STUDY | 1983 | | |
|---|---|---|---|
| SITE | 25/4/83 | 1/5/83 | Mean |
| 1 | 57.5 | 45.9 | 51.7 |
| 3 | 34.0 | 26.5 | 30.3 |
| 7 | 60.0 | 46.6 | 53.3 |
| 8 | 478 | 474 | 476 |
| 4 | 54.2 | 37.3 | 45.8 |
| 5 | 39.0 | 33.2 | 36.1 |
| 6 | 46.2 | 34.3 | 40.3 |
| 9 | 44.1 | 35.5 | 39.8 |

**Table 4.** Rainfall recorded in the catchment area (mm) (courtesy Melbourne Weather Bureau)

| YEAR / MONTH | 1981 | 1982 | 1983 |
|---|---|---|---|
| January | 45 | 43 | 35 |
| February | 17 | 20 | 6 |
| March | 70 | 82 | 47 |
| April | 33 | 86 | 62 |
| May | 75 | 106 | 95 |
| June | 86 | 58 | 119 |
| July | 100 | 54 | 87 |
| August | 123 | 39 | 87 |
| September | 32 | 72 | |
| October | 86 | 54 | |
| November | 63 | 17 | |
| December | 37 | 56 | |


REFERENCES:

American Public Health Association; (1976). Standard methods for the examination of water and waste water (14th ed.), American Public Health Association, Washington.

Dickson, I. L., Duke, G. D., and Gaymer, R., (eds.) (1982). Beneficial uses and characteristics of representative waterways in the Western Port catchment, a report to the Ministry for Conservation. Victoria College, Rusden Campus, Clayton.

Havill, D. C., Lee, J. A., and De-Felice, J. (1977) Some factors limiting nitrate utilization in acidic and calcareous grasslands, *New Phytol, 78:* 649-659.

Ladle, M., and Bass, J. A. (1981). The ecology of a small chalk stream and its responses to drying during drought conditions, *Arch. hydrobiol., 90* 448-466.

Walling, D. E., and Foster, I. D. (1978). The 1976 drought and nitrate levels in the River Exe basin, *J. Inst. Water Eng. Sci., 32:* 341-352.


## Advertisements

Council has decided that appropriate advertisements are to be run in *The Victorian Naturalist*. This measure will help meet some of the production costs of the magazine and serve to minimise subscription rates. No more than four to five pages will be alloted for advertisements. Preferred fields include the following: Photographic supplies, Bushwalking gear, Travel, Travel goods, Technical equipment (Microscopes etc), Vehicles, Seminars/Conference in Natural History.

The editorial committee would be pleased to hear from any member who may work for or patronise any firms who could be interested in placing advertisements in the magazine. Please contact the committee via the National Museum, Russell Street, Melbourne with any suggestions on potential advertisers.

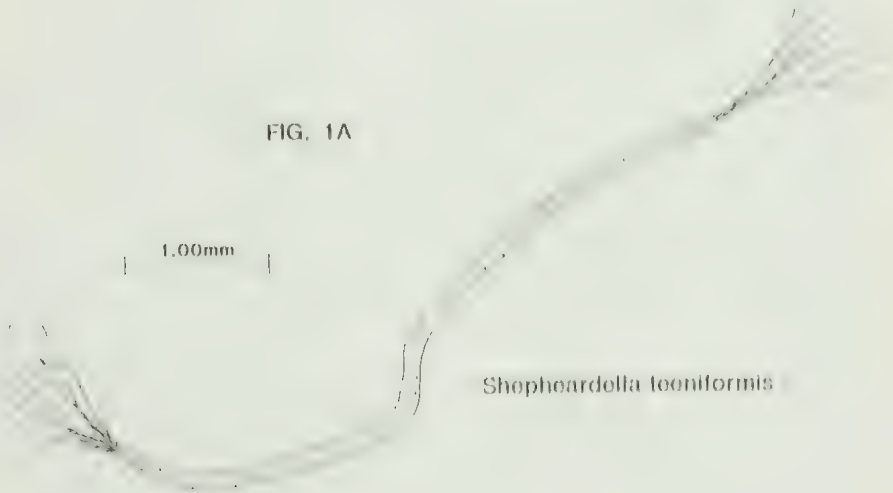
# A strange Foraminiferan found at Black Rock, Port Phillip Bay

BY D. E. MCINNES*

In mid January while searching a petrie dish containing material obtained from Black Rock, I saw a bright orange red 'worm', slightly curved but not moving. It was quite long, nearly 9 mm but very narrow, only about 0.075 mm wide — like a piece of bright red cotton. The animal moved around the container and climbed the side of the petrie dish.

On examination under low power microscope, the end of the 'worm' seemed to spread out. When it was placed under dark ground illumination at 100x magnification it was seen that the end of the 'worm' spread out like the fine roots of a plant (see Fig. 1A). The animal extended out 3 to 5 mm in a flat plane along the glass of the dish and the contents of each fine root seemed to be 'streaming' out from the main body along one side and in along the other side. These 'roots' were recognized as myxopodia — a form of pseudopodia — which spread out into finer and finer threads until almost too fine to see even under 100x magnification. Myxopodia were present at both ends of the 'worm'. If some of the threads touch together they will join up (anastomose). There is apparently an inner core to each thread and streaming along in a constant flow on opposite sides of the core, is a current of cytoplasm carrying fine particles of food to the animal and fine particles of reject material away. There was no colour in the myxopodia and as they joined up going back to the animal the single common flow of particles entered what seemed to be a fine clear 'tube'. The whole mixture of particles and the

FIG. 1A




* F.N.C.V. Microscopy Group

cytoplasm now assumed an orange-red colour and the complete contents of the animal could be seen to be slowly circulating around.

The specimen was taken to a F.N.C.V. Microscopy Group meeting for identification. The presence of myxopodia placed it in the Foraminifera, which are chiefly marine animals. They generally have very small calcareous shells (tests) and this specimen with its clear tube and wormlike appearance did not seem to fit the criteria. A suggestion was made to write to Mr Ken Bell, who works on foraminiferans, for help in identification. A letter with an illustration and description was sent and a reply was promptly received.

The specimen was identified as a foraminiferan belonging to the genus *Shepheardella.* This species belongs in the Family *Allogromiidae,* in which no hard test is formed. Members of this Family secrete a chitinoid test — the fine clear tube described earlier. The long branching pseudopods and the rapidly moving granular protoplasm are exactly as described in the 'Treatise of Invertebrate Palaeontology' Part C, p. 183. *Shepheardella* has been recorded from England (original description by Siddal, 1880), North America (Douglas, 1964) and New Zealand (Hedley, Hurdle and Burdett, 1967). Only one species has been described, *Shepheardella taeniformis* Siddal, 1880, but this is reported to have yellow protoplasm. It was noted that when a specimen from Black Rock started to retract into its test the protoplasm in the test took on a yellow colour.

The New Zealand specimens noted by Hedley, Hudle and Burdett were found crawling out from coralline algae after standing for a few days.

A search made among the seaweeds at Black Rock produced two more *Shepheardella* which were found on the brown seaweed *Caulocystis uvifera.* The seaweed was covered with stolons of the hydroid *Orthopyxis* sp. One *Shepheardella,* 9 mm long, had ¾ of its length inside a hydroid stolon. I endeavoured to extract the foram from the stolon but gave up after damaging it. Although that part of the foram inside the stolon seemed to break into pieces, the next day was entire again.

After finding the foram on the seaweed *Caulocystis* a trip was made to Black Rock to get some more but only one stem, half dead, could be found — apparently it only blows in when rough. However, among a tangle of blue-green algae two more forams were found.

Locating the forams was easy as their bright orange-red colour contrasted greatly with the algae. Probing among the algae to release the forams resulted in breaking up one of the specimens and three parts were placed close together in a petrie dish, so they would not be lost. Later that evening a strange event occurred. (see Figs. 1,2,3.) In Fig. 1 the right-hand sketch shows the foram broken nearly into two pieces and on the left is a blob of the protoplasm. The dotted area indicates the orange-red colour. Myxopodia had grown out from the end of the test and from all around the blob. The myxopodia from each touched and joined up while I was looking at them and soon afterwards the blob started to stream towards the tube, as shown in Fig. 2. The myxopodia widened quite quickly and the protoplasm could be seen moving to the right towards the tube. After a short time, less than 10 minutes, almost the entire blob had moved to join the tube as shown in Fig. 3. In the process the myxopodia of the blob had been left behind and two small blobs of protoplasm as well. Later, the myxopodia left behind were seen to have contracted into a small blob. Next morning the foram was complete — quite straight with myxopodia streaming out from both ends and no sign of any of the blobs — so it is fair to assume that the remnants had again been absorbed into

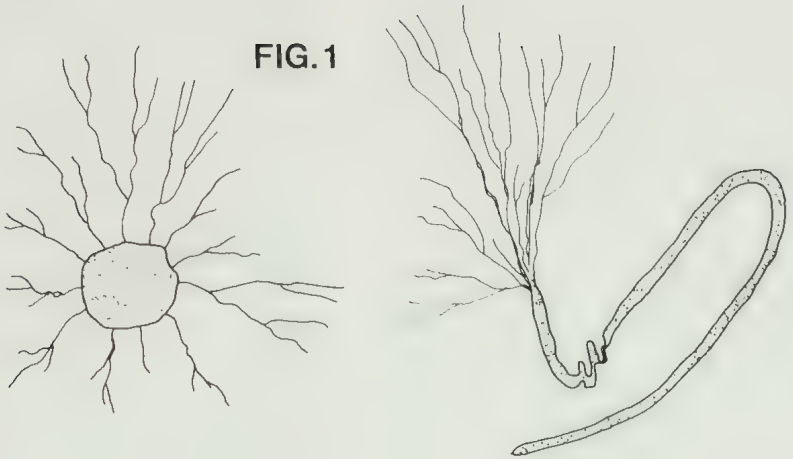


FIG.1

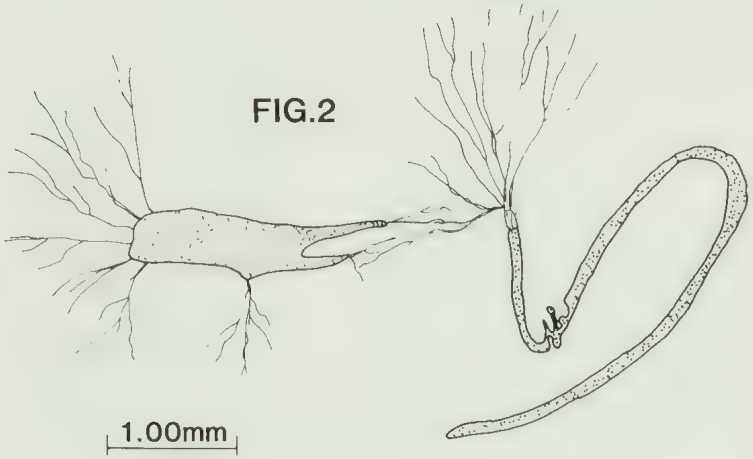


FIG.2

1.00mm

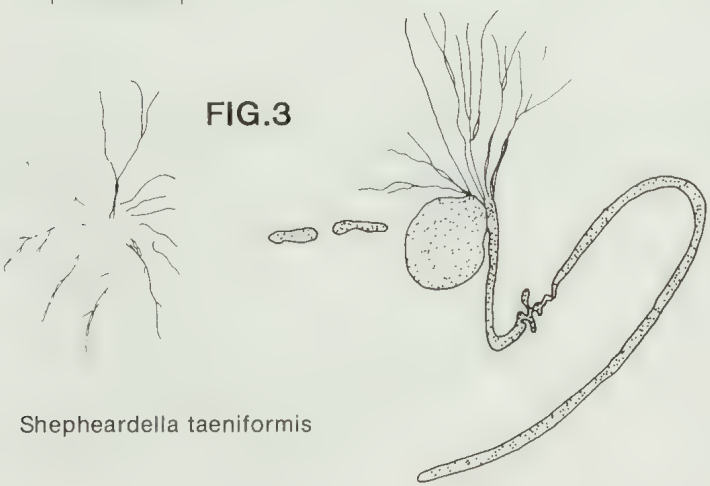


FIG.3

Shepheardella taeniformis

the protoplasm of the foram.

The *Shepheardella* that was in the hydroid stolon emerged after 4 days. On the bottom of a dish it measured 10.25 mm long and had a constriction near the centre as though it could divide there. I had arranged for a fellow member to photograph it through the microscope, when followed this amazing sequence of events:

Saturday 5.2.83.

10.00 am The 10.25 mm foram had divided into 12 parts (0.35 mm to 1.00 mm long and 0.1 mm wide) most of them complete with their own myxopodia. A photograph was taken and Fig. 4 is a drawing of this.

4.40 pm I could find only 8 parts, some had disappeared.

10.30 pm Remarkable! All except two have rejoined together. One large piece 4.5 mm long and 0.1 mm wide is connected with a small piece 1.00 mm long and 0.125 mm wide by a fine myxopodium 6 mm long. Protoplasm is streaming to the large piece.

Sunday 6.2.83

8.00 am Small piece seemed without colour and disconnected.

9.00 pm The foram seemed as though it had gone back to the original size and shape.

Monday 7.2.83

The foram is now completely as before, 8.00 mm long, 0.075 mm wide with myxopodia at both ends. What a remarkable creature!

One further observation. Two more

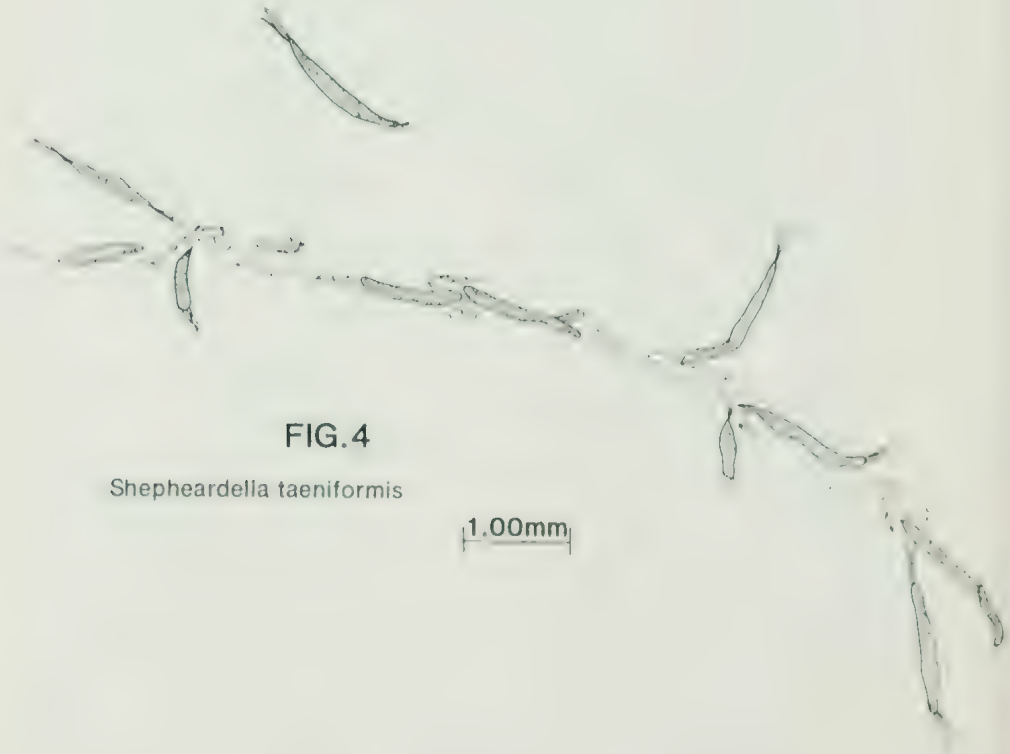



FIG. 4

Shepheardella taeniformis

*Shepheardella* were found on the seaweed *Caulocystis uvifera* and when moving them to a dish one of the forams was broken into two pieces. The two pieces were placed in a dish close together. Next morning the protoplasm had left the test of one piece and joined up with the other remaining piece to form one complete specimen, 9.00 mm long, 0.08 mm wide with myxopodia at each end and the vacated test alongside.

These last two *Shepheardella* were kept for a couple of weeks but hot weather was affecting all the marine material. The forams tended to shrink and become a bright ruby red in colour and were finally lost.

**Postcript** Nov. 18th. While checking over for the third time a small tuft of coralline sea weed from Sorrento ocean beach to see if there were any hydroids I noticed a thin orange colored thread. Could it be a foram? I carefully broke off the piece of coralline it was entangled in and placed it in a petrie dish.

Next morning, sure enough there was the orange colored foram *Shepheardella* stretched out along the bottom of the petrie dish. It was quite a size, 10.5mm long and .125mm wide with myxopodia streaming out from both ends; at one end the fine myxopodia measured 7.0mm in length.

This discovery made me probe the tuft of coralline very carefully and the result was finding three more *Shepheardella* all entangled in the weed. Again they were placed with the pieces of weed in the petrie dish, where by next morning they had detached themselves from weed and were on the bottom of the dish.

They were all .125mm wide and were from 7 to 9mm in length and color varied from orange to reddish orange; from one the myxopodia extended to a length of 14mm.

Perhaps they are very plentiful if we look carefully enough.

REFERENCES


Douglas, R. (1964). An occurrence of *Shepheardella* Siddall (Foraminiferida) from the west coast of North America. *J. Protozool., 11:* 484.

Hedley, R. H., Hurdle, C. M. and Burdett, I. D. J. (1967). The marine fauna of New Zealand. Intertidal Foraminifera of the *Corallina officinalis* zone. *N.Z. Ocean. Inst. Mem.*, 38.

Siddall, J. D. (1880). On *Shepheardella* an undescribed type of marine rhizopod; with a few observations on *Lieberkuhnia. Quart. J. Micr. Sci., 20:* 130-145.


---

**Paul Dimitri Generi** passed away on the 24th September, 1983.

Paul was a long standing member, active in the Microscopical Group. He produced a number of outstanding movies on aquatic life and made many contributions to the preparation of aquatic life for microscopical examinations.

An obituary will appear in a forthcoming issue of Naturalist.

---

# Tawonga Bog Revisited: The History of a Low Altitude Peat Deposit

By A. P. Kershaw* and J. E. Green*

## Introduction

Fifteen years ago a raised *Sphagnum* bog community, from the Kiewa Valley just north of Tawonga, was described in *The Victorian Naturalist* by R. K. Rowe (1968). This was considered to be of special interest because it represented an unusual low altitude (c. 350m) occurrence of what is basically a sub-alpine assemblage. In addition to Sphagnum moss *(Sphagnum cristatum)*, the bog supported a variety of shrubs including mountain heath-myrtle *(Baeckea utilis)*, alpine bottle brush *(Callistemon sieberi)* and short-flowered heath *(Epacris brevifolia)*.

Following the arguments of Costin (1954) for the present status of bogs on the Monaro Tableland, Rowe inferred that such low altitude bogs could have been more extensive during the last glacial period, which ended at least 10,000 years ago, and suffered under subsequent increased temperatures or reduced precipitation levels. These climatic changes, together with more recent disturbances associated with the agricultural and roadmaking activities of European man, were considered by Rowe to be threatening to the very existence of Kiewa Valley bogs. Therefore this site, as one of the few, if not the only, bog remaining should be preserved.

It was decided, as part of the Quaternary Studies course at Monash University in 1982, to undertake an intensive study of the site in order to test these views about its history and status. Fortunately the bog contained a depth of organic sediment suitable for pollen analysis to allow a reconstruction of the development and environmental history of the site.

## Methods

After examination of the stratigraphy of the site by coring with a peat corer, the deepest part of the bog was selected for the collection of a core for detailed analysis. The extracted core, 2 metres in length, was described in the field then taken back to the laboratory. Here, a section from close to the base was submitted to the Radiocarbon Laboratory, Sydney University for dating while samples for pollen analysis were taken at 10 centimetre intervals. Unfortunately, because of the difficulty the corer had in collecting extremely fibrous peat near the surface, no sample was obtained from a depth of 10 cm. Pollen samples were prepared by standard chemical techniques to remove extraneous material and make the pollen clearly visible under the microscope and then the contained pollen and spores were identified and counted.

## The pollen diagram

Selected results are shown on the pollen diagram (Figure 1). All pollen and spore types are shown as percentages of the total pollen recorded in each sample. The diagram has been divided into zones to aid in description of major changes in pollen representation.

Zone 3 is characterised by very high values for a group of ferns which inhabit

* Department of Geography, Monash University, Clayton, Victoria, 3168

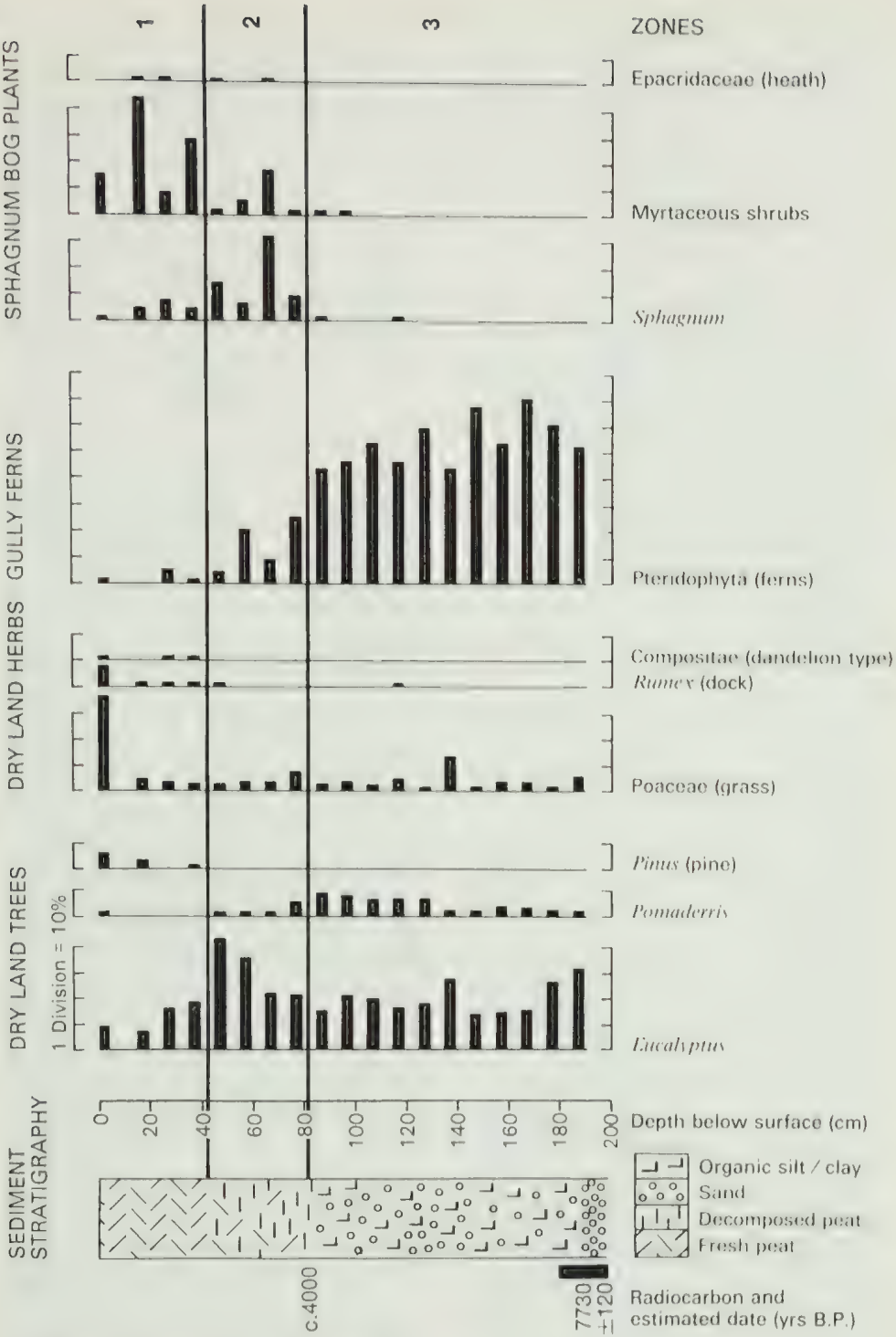



Fig. 1. Selected features of the pollen diagram from Tawonga Bog, Kiewa Valley, Victoria.

wetter forests and moist gullies. These include the tree ferns *Cyathea* and *Dicksonia* and bats wing fern, *Histiopteris*. There are also consistently high values for *Eucalyptus* and the highest representation in the diagram of *Pomaderris*. The sediment is a mixture of sand, which in places is concentrated into bands, and dark-grey silty-clay.

It is likely that the bulk of the sediment was deposited by a stream which flowed freely over the present site of the bog. The fern spores were most likely derived from plants growing along the stream banks and transported by water to the site. Pollen from *Eucalyptus* and *Pomaderris* would have blown in from the surrounding vegetation. The relatively high values for *Pomaderris* suggest that wet sclerophyll forest was extensive within the region. All available evidence points to the fact that conditions were very moist and it is likely that effective precipitation was higher than that of today.

The radiocarbon date of 7730 ± 120 years before present (SUA: 1931) provides a minimum age only for the commencement of these conditions. It is possible that similar sediments exist below those cored but difficulty in penetrating the basal sand band prevented the recovery of older material.

Marked changes in pollen proportions occur around the zone 3/2 boundary. *Pomaderris* and the ferns decline while there are dramatic increases in *Sphagnum* and myrtaceous shrub values. Epacridaceae is present for the first time. In the sediment stratigraphy sub-fibrous to highly decomposed peat replaces the largely inorganic material.

The association of *Sphagnum*, myrtaceous shrubs and Epacridaceae suggests the development of a Sphagnum bog similar to that existing today. Pollen of *Baeckea* and *Callistemon* is prominent in the myrtaceous shrub component while the Epacridaceae pollen could certainly have derived from *Epacris breviflora*. It is proposed that a reduction in stream flow or flood frequency resulted in a decrease in the amount of inorganic matter carried by the stream and produced a calm environment suitable for the colonization and development of Sphagnum bog. This reconstruction is supported by a reduction in *Pomaderris* values which indicates a contraction of wet sclerophyll forest most likely as a result of reduced precipitation.

The commencement of Sphagnum bog growth is tentatively dated at 4000 years before present. This date was arrived at by interpolation from the known ages at the top and base of the core, taking into account pollen concentrations within the samples as a measure of sediment accumulation rate.

At the Zone 2/1 boundary there are decreases in *Eucalyptus*, fern and *Sphagnum* values, an increase in myrtaceous shrub percentages and first appearances of *Pinus* and Compositae (Liguliflorae). Within Zone 1 *Rumex* is consistently present and the sediment is fibrous *Sphagnum* peat.

The major representatives of *Rumex* and Compositae (liguliflorae) within the area are introduced weeds of disturbance and their consistent representation, together with the presence of the introduced plantation tree *Pinus*, indicates that this zone falls within the period of European man's occupation. The reduction of *Eucalyptus* to lower values than in any other part of the diagram and almost complete disappearance of *Pomaderris* reflects the replacement of forests by pastures within the area.

On the bog itself, the increase in myrtaceous shrubs relative to *Sphagnum* could be interpreted as a more extensive woody plant invasion of the peat surface under drier conditions. On the other hand the fresh nature of the peat and rapid accumulation rate during this

European phase suggests that the condition of the bog is at least as healthy as it ever has been. The lower *Sphagnum* values may simply mean that sporing has been reduced under conditions very conducive to vegetative growth. The very high Poaceae and *Rumex* values in the surface sample do suggest some invasion of the bog surface by pasture species in recent times but much of the Poaceae increase may be due also to the planting of exotic grass species which tend to have higher pollen production than native species.

## Discussion

The pollen diagram provides evidence of vegetation changes within the basin of the present bog and in the surrounding area through the last 7500-8000 years. It is clear that a raised Sphagnum bog did not develop until about 4000 years ago and it is not a relict of the Late Pleistocene as suggested by Rowe (1968). The development of the bog within the latter part of the Holocene, though, is consistent with evidence from other sites in the highland region (see Kershaw *et al.* in press). On nearby Mt Buffalo, pollen diagrams provide a picture of vegetation and environmental changes within the subalpine zone (Binder 1978, Binder and Kershaw 1978, Williams 1980). Although organic sediments began to accumulate from the end of the last glaciation under increased precipitation and temperatures, the existence of raised Sphagnum bog is only evident within the last few thousand years.

The preferred explanation for the development of raised bog at high altitudes has been a decrease in temperature and consequent increase in effective precipitation to critical threshold levels for bog growth. It is unlikely that, despite cold air drainage into the Kiewa Valley, temperatures reached similarly low levels at this low altitude site. The suggestion here that a decrease in stream flow or variability led to more stable conditions suitable for the formation of raised bog provides an equally plausible explanation for high altitude bogs which have developed within drainage channels.

**Acknowledgements**

We thank Dr Jim Peterson, Merna McKenzie, Ian Sluiter, Kathie Strickland, Teresa Crowley and the 1982 Quaternary Studies students for assistance with fieldwork and Mr J. Edmondson and Mr J. Sullivan for permission to undertake this fieldwork on their properties. Neville Walsh and Bob Chinnock kindly identified plant specimens while Gary Swinton drafted the diagram and Helen MacDonald typed the text.

REFERENCES

Binder, Renate (1978). *Stratigraphy and pollen analysis of a peat deposit, Bunyip Bog, Mt Buffalo, Victoria.* Monash Publications in Geography 19, Dept. of Geography, Monash University.

Binder, Renate and Kershaw, A. P. (1978). A late Quaternary pollen diagram from the southeastern highlands of Australia. *Search 9:* 44-45.

Costin, A. B. (1954). *A study of the Ecosystems of the Monaro Region of New South Wales,* Govt. Printer, Sydney.

Kershaw, A. P., Southern, W., Williams, J. M. and Joyce, L. J. (in press). The vegetation record from the southeastern highlands of mainland Australia 40,000 — 3000 B.P. *In* J. M. Bowler, J. Chappell and J. Hope (Eds), *Proc. CLIMANZ Conference 1981.* Aust. Acad. Sci.

Rowe, R. K. (1968). Rare Bog Community at Tawonga. *Victorian Nat. 85:* 123-124.

Williams, Janet (1980). *Crystal Bog, Mt. Buffalo: A palaeoecological study of a subalpine peat bog.* Working Paper No. 8, Dept of Geography, Monash University.

## Little Desert Wildlife: An Illustrated Checklist

I. R. McCann
Little Desert Tours Pty. Ltd., Nhill.
1983
$4.00

As this title suggests, this booklet is a list of species of mammals, birds, reptiles and amphibians occurring in the Little Desert region of western Victoria. It includes 120 colour photographs depicting 104 species; 62% of the mammal species, 32% of bird species, 83% of reptile species and 89% of amphibian species are illustrated.

Most of the photographs are of a very high standard and some of the small mammal and reptile portraits are particularly fine. The sequence showing the newly-hatched Shining Bronze-Cuckoo ejecting the chick of its foster parents from the nest is, to my knowledge, unique for an Australian cuckoo and deserves to be widely seen. Unfortunately some plates have suffered in printing and have a reddish or bluish wash.

The area covered is bounded to the north by the Western Highway, to the east by the Wimmera River, to the south by the Horsham-Goroke Road and to the west by the border between Victoria and South Australia. Thus, it includes several habitats apart from the sand dune heaths, Brown Stringybark low open-forest, Yellow Gum woodland and mallee broombush open-scrub of the Little Desert proper. In particular, it includes extensive cropping and grazing land, saline lakes, open freshwater lakes and River Red Gum woodland. This explains the inclusion of some species not normally associated with the Little Desert such as Yellow-footed Antechinus, Banded Stilt and Eastern Blue-tongue Lizard. However, it does not explain the inclusion of Eastern Grey Kangaroo, Feathertail Glider, Mitchell's Hopping Mouse, Chestnut-crowned Babbler or White-browed Treecreeper for which I can find no adequately documented records from the area. Their inclusion ought to have been justified, otherwise they should have been omitted.

Apart from these ring-ins, the mammal, bird and amphibian lists are accurate and complete. However, *Litoria peroni* should be included and the *Neobatrachus* species are *pictus* and *sudelli*. Some specific names used for bats, reptiles and amphibians are now outdated but, given the present state of taxonomic confusion in these groups, this is understandable. Five extra reptilian species should be included: *Diplodactylus vittatus, Delma australis, Hemiergis decresiensis* (found on Mitre Rock), *Morethia boulengeri* and *Menetia greyi*. The inclusion of *Leiolopisma metallica* is presumably an error since it is not recorded west of Queenscliff. The plate labelled Delicate Skink in fact depicts a Garden Skink *Lampropholis guichenoti*.

Each species is assigned a status rating and a distribution category (which in this case is actually a habitat category). The term mallee eucalypt 'forest' used here is confusing; openscrub of shrubland would be more accurate. With qualitative status and habitat categories such as those used, complete agreement between workers is almost impossible to achieve. Therefore, I was encouraged to find I had very few quibbles; the only major one being the habitat of Calamanthus which, in my experience in the Little Desert, is low heath not open-forest or woodland.

Apart from the questions about the inclusion or exclusion of some species, I found this booklet to be well researched, accurate and beautifully illustrated. At $4.00 it is excellent value and I thoroughly recommend it to all who intend visiting the Little Desert.

**P. W. MENKHORST**

## *Naturalist Review*

### The Australian Museum — Complete Book of Australian Mammals

Ed. Ronald Strahan
Angus & Robertson, Sydney, 1983.
$45.00

The unique mammals of Australia have attracted fascination from naturalists since their discovery, yet our knowledge of their natural history has until recently remained appallingly meagre. The formation of the Australian Mammal Society in the late 1950s provided a catalyst to research on Australian mammals, and with the publication of *The Complete Book of Australian Mammals*, we at last have a comprehensive summary of much of the information resulting from this research. The text provides an account of every living species, elegantly illustrated with colour photographs selected from the collection of the National Photographic Index. In many instances these photographs provide us with the first published illustrations that are adequate for identification of species. In the text it is possible to find where most species live, what they eat, their life style, some information on their reproduction and growth, the various factors leading to their death, and an evaluation of their present status. Distribution maps are provided, but the scale of these is such that they offer only a general indication of distribution. In addition the text provides some measures of size, a short diagnosis, a list of recent synonyms, common names, subspecies and two references which are intended to aid those seeking additional information to enter the literature.

By depending upon the contributions of more than 100 contributors most of whom have working familiarity with particular species, Ronald Strahan has assembled a text which is up to date and in many places provides hither-to unpublished information. Not only will this provide an important source of information for naturalists curious about Australian mammals, but it also draws attention to those species for which our knowledge remains meagre.

As with any book with ambitious objectives, *The Complete Book of Australian Mammals* has its shortcomings. The accounts of species are not consistent in their content and some tend to reflect the specialized interests of the contributor. I wonder whether its audience will be interested in a discussion on the chromosome races of rock wallabies. More unfortunate is the use of a higher classification which in places is inconsistent with current usage. There have been radical adjustments to the higher classification of marsupials over the past five years, and while some changes (e.g. within the Macropodidae) are recognized, elsewhere (e.g. within the Dasyuridae) they have been ignored. It is unfortunate that inconsistencies of this kind should occur in a book which will obviously attract wide usage.

Despite these shortcomings, the publication of *The Complete Book of Australian Mammals* is a milestone in the study of the natural history of our fauna, and will prove a very rewarding acquisition for naturalists who explore its text.

**A. K. LEE**

## FIELD NATURALISTS CLUB OF VICTORIA

### Reports of recent activities

**General Meeting**
**Monday, 12th September**

**The topic** for the evening, being addressed by several speakers, was the recovery and regeneration of wildlife after bushfire, with particular reference to the recent 'Ash Wednesday' fires.

Mrs Hilary Weatherhead outlined the

work done by the Botany Group in monitoring the revegetation of a patch of bush in Courtney Road, Belgrave South, burnt by an intense fire on 16th February. From observations made approximately every three weeks the Group has been able to construct a 'calendar of recovery'.

A series of slides was shown that most effectively displayed the total devastation caused by the fire and the amazing ability of the bush to bounce back; within 9 weeks of the fire blue-bottle daisies were found flowering.

Particular features of the early stages of recovery were the abundance of fungi, quite large numbers of orchids and also the out-of-season (Autumn) occurrence of yellow stars. By mid-winter many shrubs were regrowing from their bases, e.g. dogwood. After 4 months there were large numbers of daisies, fungi, grasses, ferns and caterpillars which found abundant food in the mass of regrowth, particularly amongst the eucalypts. These caterpillars brought with them the associated insectivorous birds.

It was felt that the fire would cause local extinctions of some species while it would favour others, in particular bulb species (orchids, grasses), and those with either woody nuts or cones (hakeas and banksias) or tough seed coats (e.g. acacias).

The next speaker, Charlie Meredith, directed his discussion to the effect of bushfires on birds and in particular focused his attention on the effects of fire in relation to the management of a declining species, the Ground Parrot.

The Ground Parrot is a patchily distributed bird which favours low heathland usually close to the coast. Charlie found that the single most critical factor in the birds survival is the presence of sedges, with parrot numbers being closely paralleled to the density of these plants. In relation to fire there was no long-term effect on the bird's well-being as long as the sedges returned in the recolonising flora. In the heathland, populations of the Ground Parrot return in 18 months to 3 years after the fire and reach a peak in numbers after 15-17 years. After approximately 20 years without a fire the species becomes absent and this appears to be due to the patterns of plant recolonisation. In the initial period after a fire species such as *Xanthorrhea* grow very quickly and are able to suppress the other shrub vegetation for approximately 15 years. Then there is a second 'spurt' of growth by the shrub species whereby the sedges are eventually blocked out, and the Ground Parrot subsequently disappears.

At the other extreme we see the effects of too frequent burns, i.e. less than 6-8 years between fires. Such a fire regime degrades the heathland floristically and removes the Ground Parrot with long-term effects. In heathlands that are known to have been burnt thus, the Ground Parrot has failed to recolonise even after a long period of time.

East Gippsland has been the birds' stronghold with Croajingalong National park supporting approximately 50% of the species' Victorian population. In the huge February fires approximately two-thirds of the heath in East Gippsland was burnt with the result being that there are now only effectively 3 age classes of heath in that area. This has posed management problems in relation to ensuring the long-term survival of the Ground Parrot.

Charlie then spoke briefly about the effects of fire on another type of habitat, namely Mallee, where it has been seen that it is only after some 20 years that the bird communities return to their former richness.

In relation to birds fleeing the fires Charlie remarked that in general birds will not leave their territory and that they will either 'double-back' over or through the fire or they will perish

rather than cross into another bird's home-range.

Andrew Bennett (Mammal Survey Group) was able to give some indication of what happened to mammal populations subjected to the effects of an intensive wildfire. Andrew has been studying the mammal populations in patches of bush in the Naringal area, near Warrnambool, for the past 4 years. This was an area in which about 60,000 hectares of land was burnt on or around 16th February.

Andrew's trapping results and general observations after the fire confirmed the sort of population reduction that would be expected from a fire of this nature. Small mammals such as the Potoroo, Brown Bandicoot, Bush Rat and Brown Antechinus which Andrew formerly trapped in fairly large numbers were reduced to 1 or 2 individuals or sometimes not trapped at all. Other mammals normally spotlit or seen as incidental sightings such as possums, kangaroos, etc were also greatly down on numbers recorded. Andrew felt that one possible exception to this general trend of decimation might be the Echidna, largely due to its ability to burrow. Also, as ants were common after the fire there would be no shortage of food for this animal.

Andrew noted that most of the animals encountered after the fire appeared highly stressed. Trapped animals, on their release, would make a mad scramble, often darting down old rabbit burrows. There were also a (comparatively high?) number of roadkills, probably as the animals made frantic dashes for shelter.

Andrew felt that the common species would recover but that because of the fragmentation of the bush that had already existed in this area previous to the fire (due to the clearing of land for farming) there could be localized extinctions of species unless migration occurred into these patches. As with birds, the available information suggests that generally mammals do not disperse either before or after a fire, remaining within their home ranges.

Mention was made of 3 factors very important to the survival of mammals as regards to fire:—

(i) intensity — intense fires are catastrophic for mammals generally.

(ii) timing — e.g. worse if fire is around the breeding season (can wipe out both generations).

(iii) frequency — adaptation to particular fire regimes.

**Conservation:** Malcolm Turner reported that a recent delegation from several conservation groups and including the F.N.C.V. — to several Ministers put forward its views regarding the Alpine Resorts Bill and was able to gain some minor amendments to the Bill.

Several members from the F.N.C.V. recently made known the Club's views concerning the restructure of the departments of Planning, Conservation, Crown Lands and Survey, and the Forests Commission into two new departments (see last Naturalist). In short the major fear was that in the amalgamation the conservation-orientated sections may loose their autonomy.

Malcolm also reported on the Conservation Committee's current work on the Bogong National Park report and stressed that any relevant information that members might have would be greatly welcomed. Comments on the Rodger Management Block Draft Plan had been compiled and sent off to the Forests Commission.

**Exhibits:** From bushfire-ravaged Courtney Road came a selection of mosses and lichens. Another exhibit of an unidentified yabby from the Grampians was just one of many individuals seen by one member at what he felt was an unlikely site.

The President displayed a book, "Orchids of Australia" that had been presented to the Club by the Botany Group in 1970, but had only recently had its inscription inserted.

From Black Rock came two seaweeds, an unidentified one and *Bryopsis*, and also the colonial sea squirt *Botryllus* in which the circulation of blood could be clearly seen under the lower power microscope.

A fungus, tentatively identified as *Auricularia* had been found growing at Black Forest, on an area burnt in the Mt Macedon fire.

**General Meeting**
**Monday, 10th October**

**Members** observed one minute's silence on the recent passing of Paul Genery. Urwin Bates spoke of Paul's love of microscopy — he was active in the microscopical group and made several movies on pond life.

**Honorary membership** was conferred on Thomas Byrne, who recently completed 40 years membership with the club. Thomas was introduced to the club by T. S. Hart, a name that will be familiar to some of the older club members.

**Speaker** for the evening was Mr Donald Johnson from the United States who, after giving some of his first impressions of the Australian environment went on to outline some aspects of the birdlife of North America, in particular the state of Iowa, making some comparisons with Australian species. For instance, a large component of the Australian avifauna — honeyeaters — are absent from America, where the equivalent is the hummingbird (the smallest bird in Iowa) which has the ability to remain perfectly still, and even reverse, in flight.

Donald explained that there are few flycatchers in America and that these are drab by comparison to Australian species. A group of birds with many representatives in the U.S. are the new world wood warblers with 51 species occurring there (31 in Iowa). These birds are migratory, to the West Indies and Mexico. It seems remarkable that each species has found a niche for itself considering the number, and relative similarity, of the species present.

It was interesting to hear that there is also a problem in the U.S. with native birds (e.g. bluebirds — a type of thrush) being deprived of nesting hollows due to competition from starlings, in particular.

Other points noted include:—
— America possesses approximately two-thirds the number of Australian species of raptor.
— Cowbirds — parasitize nests like cuckoos, these species have a shorter incubation time than their hosts.
— Soft-shelled eggs (DDT) problem appears to be declining.

Donald illustrated his talk with many slides of birds, most having been photographed in the hand during bird banding sessions (of which Donald takes an active part).

**Reports:** The FNCV's display at the Royal Melbourne Show was reported as being rather poor and it was felt that better organization and exhibits were needed.

In reporting the VFNCA weekend at Ocean Grove Hilary Weatherhead said that many birds were seen, including the Orange-bellied Parrot, and a large number of orchids and sundews were found.

**Exhibits:** There were a number of exhibits as follows:—
— hydroids from Black Rock
— egg cases of a praying mantis with some already having been hatched
— larvae of a cup moth
— caterpillars eating acacia leaves
— two fungi from Ocean Grove, the puffball *Scleroderma flavidum* and the polypore fungus, *Coltriciella oblectans*, with hexagonal pores
— from Ironbark Ridge (near Point Ad-

dis) came the liverwort, *Marchantia berteroana* showing the gemma cups (vegetative reproductive structures) and the male reproductive organs. Also on display was the moss *Funaria hygrometrica*, a very common species of burnt areas

— an album of photographs of two early FNCV expeditions, one to King Island in 1887 and the other to the Furneaux and Kent Groups in 1893.

**Nature Notes:** One member reported seeing a Fantailed Cuckoo in North Balwyn.

**General Meeting**
**Monday, 14th November**

**On presenting** the Australian Natural History Medallion to Trevor Pescott, Dr Jim Willis outlined Trevor's outstanding contribution to natural history study and the conservation of wildlife and its habitat, particularly in the Geelong region through his work with the Geelong FNC (founding president 1961-64) and his writings, which include a column for the Geelong Advertiser since 1960 and four books on natural history.

**After giving thanks** on receiving the Medallion Trevor turned to the topic of the evening's talk in which he discussed many of the 380 or so bird species which occur in the broad area around Geelong (including the Otways and the You Yangs), and how the various changes brought about by man has affected them.

In the early years of settlement there was large scale clearing of habitat, the uncontrolled hunting of species, and so on, with the result that many species declined or disappeared altogether very early on. Examples of these are the Emu (vanished by the 1850's), Mallee Fowl (reported in the Brisbane Ranges until the 1880's), and the Bustard (disappeared at the turn of the century, mainly due to shooting and predation by foxes). Attempts have been made to re-introduce some of these species, e.g. Emu (uncuccessfully), while others such as the Magpie Goose have re-introduced themselves to a certain extent (from populations being bred at the Serendip Wildlife Research Station, near Lara). Other species that have obviously declined are Plains Wanderer, Grey-crowned Babbler, Southern Stone Curlew, Hooded Robin, Southern Whiteface, and Black-chinned Honeyeater.

Trevor stated that the wetlands of this region are of international importance and that there are especially large congregations of birds in summer due largely to the presence of migratory waders over these months. However, this habitat has sufferred from drainage schemes and birds such as the Brolga and Lewins Water Rail have declined as a consequence.

On the other hand some species appear to have increased in numbers over recent years, e.g. Silver Gull on Mud Island — established early 1960's — now approximately 10000 pairs; the Crested Tern; and the Yellow-tailed Black Cockatoo which appears to have benefited from the proliferation of pine plantations in the Otways.

This region is also important as a stronghold for several species, probably the most notable being the Orange-bellied Parrot, where 60 to 70 individuals occur at Point Wilson, and approximately 25 on Swan Island. However, both populations exist with the threat of development looming over them. A significant proportion of the known numbers of the Sooty and Pied Oystercatcher resides here and there is also a good population of the uncommon White (Grey) Goshawk in the Otways.

Through his talk Trevor demonstrated the area's importance for conservation of a multitude of Australia's bird species reinforcing his case with many of his own excellent slides.

**Exhibits:** Under the microscope was displayed the egg mass of a shellfish (?

*Siphonaria* sp.) from a rock platform at Sorrento. Also on show from Sorrento were male and female flower wasps (Family Tiphiidae).

One member had on display 12 species of introduced grasses which he had collected from around Caulfield racecourse.

Another exhibit of wasps enabled a direct comparison between two introduced wasps and a native wasp. The two introduced wasps, *Vespula germanica* (German wasp) and *V. vulgaris* have both been introduced from Europe, the former first appearing in Melbourne as recently as 1977. Both have a painful sting. The native wasp is smaller and lacks the sting.

Finally, one member brought in a skull from Blackhill (near Kyneton) which was later tentatively identified as being that of a Ringtail possum.

**Nature Notes:** In a report of an excursion to Wyperfeld National Park the great abundance of flowers and grasses (many in seed) was emphasised. It was also noted that seven bat species had been identified, three species being new additions to the Park's list.

The introduced white vineyard snail is observed to be spreading rapidly inland and Brian Smith at the Museum of Victoria would welcome any specimens collected.

## VALE — JEAN BLACKBURN, 1909-1983

It scarcely needs to be said that almost from the beginning, the ladies have played a significant and important part in the life of the Club. Many eminent women have been and are numbered among its members. All the offices of the Club have been held, at one time or another, by them. Hosts of others have served its interests in less prominent ways. Happily, many such people are still with us but one may be sure that those who have passed on are remembered with affection by those who were their contemporaries. Such a one is Jean Blackburn, a member of 37 years standing who, in her 74th year and after a long illness, died on 14th July, 1983.

Jean belonged to a number of well known voluntary organizations, perhaps the first being the Girl Guides. For much of her life she was an active member of the Melbourne Women's Walking Club, having joined that organization in 1934 — nearly fifty years ago. Within a few years she had become a member of its committee and, during the years that followed, usually served as a member of it or else as the Club's President or Vice President, offices to which she was elected on several occasions.

In 1935 she became a member of the Y.W.C.A. and took a leading part in its gymnasium and outdoor activities.

In 1946 she joined the Field Naturalists' Club of Victoria and it was not long before she became involved in its activities, participating in the pursuits of its botany group and the Club's general excursions. She was one of that party of members that spent an enthusiastic few days exploring Rushworth and Whroo in October, 1948. She wrote about it in the Victorian Naturalist.

In the following year she became the Club's excursions secretary and was responsible for arranging the general excursions during the ensuing two years. Throughout the years of her association with the Club she has taken part in many of its outdoor activities and, during field excursions, her considerable knowledge of the natural history of her home State was drawn upon eagerly by her companions. As a bushwalker she managed to penetrate into many of the wilder parts of Victoria and other States and Territories. Some of us still recall with pleasure the Club's excursion to Central Australia in 1960.

Most of us dutifully climbed Ayer's Rock to explore its summit and

photograph whatever had to be photographed — Jean along with the rest of the party.

However, she had the misfortune to operate her camera with the film unattached to the advance mechanism, something she discovered after arriving back at camp. Next morning, before breakfast, with the spool properly responsive to the advance lever of her camera, she again sped up to the summit of the Rock and got her pictures. She must be one of few people who have climbed Ayers Rock twice in 24 hours!

Seven years later she went back to the Centre with another party of naturalists, botanists and walkers. In the company of her friend Laura White she explored some of Mount Sonder in search of a rare plant that was known to have been collected there in the previous century. Jean re-discovered it. Laura recognized it and, together, they despatched by air mail to Melbourne enough material to permit of the plant being propagated from cuttings. In due time the plants flowered and it was seen that the plant Mueller had believed to be *Prostanthera schulzii* was, in fact, one of two species of another but allied genus, *Wrixonia.* Its story is told in the Victorian Naturalist, 1969: 86, 132.

Naturally, with her lively interest in native plants, she became a member of the society established by Winifred Waddell — the Native Plants Preservation Society of Victoria. She joined it in 1956 and, from 1975 onwards, was a member of its committee of management.

When the Victorian National Parks Association came into being in 1952 Jean played a part in its activities — first as the delegate for the Melbourne Women's Walking Club and then as a member in her own right in the following year. Five years later she was installed as the Association's honorary treasurer, an office she held with distinction for the following quarter of a century. Her special contributions to the welfare and development of both the Walking Club and the VNPA were recognized by her being elected an honorary life member of those organizations.

When the Conservation Council of Victoria came into existence in 1970 it became the mouthpiece of most of the nature conservation organizations in Victoria. As was the case with the VNPA, they were represented by appointed or elected delegates. It was practically inevitable that Miss Jean Blackburn should become a delegate. She represented the Melbourne Women's Walking Club at the general meetings of the CCV but because of her membership of several of the other affiliated clubs, societies and associations and her long experience and wide knowledge of the Victorian scene what she had to say carried more weight with the Council's executive than she herself would have been prepared to claim. She readily gave credit to others but was always far too modest to claim any for herself. She was that kind of person. The writer of this tribute has good reason to appreciate the sterling qualities of Jean Blackburn. Although he knew little of her private life he came to know a lot about her career as a conservationist. If there was a good conservation cause to be helped in a practical way Jean, somehow, found time to help. She was a good typist, book-keeper, accountant, treasurer, bushwalker, travelling companion and listener. In her moments of relaxation she read widely and listened with deep enjoyment to symphony orchestras and singers of renown. She had the naturalists' keen awareness of the special character of the environment of her native land and one is inclined to believe that she knew at first hand more of it than most of us could ever hope to see.

J. Ros Garnet

21.11.83

# *Field Naturalists Club of Victoria*

Established 1880

Registered Office: FNCV, c/- National Herbarium, Birdwood Avenue, South Yarra, 3141.

**OBJECTS:** To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

*Patron:*
His Excellency Rear Admiral SIR BRIAN S. MURRAY, KCMG, AO.

**Key Office-Bearers 1983-1984**

*President*
Miss WENDY CLARK, 27 Rangeview Grove, North Balwyn, 3104 (859 8091 A.H.)
*Vice-President:*
*Hon. Secretary:* Mrs SHEILA HOUGHTON, 30 Golf Links Crescent, Dingley, 3172 (551 2708 A.H.)
*Hon. Treasurer:* Mr DAVID DUNN, 3 Allfrey Street, East Brighton, 3187 (578 5753)
*Subscription-Secretary:* Miss H. MALCOLM, c/- FNCV National Herbarium, Birdwood Avenue, South Yarra, 3141
*Editorial Material:* Forward to Ms J. U. PHILLIPS, Museum of Victoria, Russell St., Melbourne, 3000.
*Librarian:* Mrs JANE CALDER, c/- FNCV National Herbarium, Birdwood Avenue, South Yarra, 3141
*Excursion Secretary:* Miss MARIE ALLENDER, 19 Hawthorn Avenue, Caulfield, 3161 (527 2749)
*Book Sales Officer:* Mr D. E. McINNES, 129 Waverley Road, East Malvern, 3145 (211 2427)

**Group Secretaries**

*Botany:* Mr PETER CARWARDINE, 2a Victoria Road, Malvern, 3144 (509 0622 B.H. 211 8958 A.H.)
*Day Group:* Mrs E. L. GILLESPIE, 23 Wild Cherry Road, Carnegie 3163 (578 1879)
*Geology:* Miss HELEN BARTOSZEWICZ, 23 Henry Street, Kensington, 3031 (376 1706 A.H.)
*Mammal Survey:* Mr LANCE WILLIAMS, 29 Erica Crescent, Heathmont, 3135 (879 1962 A.H.)
*Microscopical:* Mrs ELSIE GRAHAM, 147 Broadway, Reservoir, 3073 (469 2509)

**MEMBERSHIP**

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

**Subscription rates for 1984.**

| | |
|---|---|
| Metropolitan Members (03 area code) | $18.00 |
| Joint Metropolitan Members | $21.00 |
| Country/Interstate/Retired Members | $16.00 |
| Joint Country/Interstate/Retired Members | $18.00 |
| Student (full-time) | $12.00 |
| Junior (under 18; no Victorian Naturalist) | $3.00 |
| Subscription to Victorian Naturalist | $16.00 |
| Overseas Subscription to Victorian Naturalist | $22.00 |
| Individual Journals | $2.50 |

Jenkin Buxton Printers Pty. Ltd. 1-13 ABBOTSFORD ST WEST MELBOURNE 328-4774 329-7959